BOMBAY-POONA

A SOUVENIR

OF THE

TWENTY-FIRST MEETING

OF THE

INDIAN SCIENCE CONGRESS

HELD AT BOMBAY

JANUARY 1934

THE ARYABHUSHAN PRESS, POONA

THE TWENTY-FIRST
INDIAN SCIENCE CONGRESS
BOMBAY 1934

Patron:

The Right Honourable Michael Herbert Rudolf Knatchbull
Baron Brabourne, G. C. I. E., M. C.,
Chancellor of the University and Governor of Bombay.

President:

Dr. Meghnad Saha, D. Sc., F. R. S., F.A.S.B.,
Professor of Physics, University of Allahabad.

Chairman of the Local Committee:

V. N. Chandavarkar, Esq., B.A., Bar-at-Law.
Vice-Chancellor of the University of Bombay.

Vice-Chairmen of the Local Committee:

R. H. Beckett, Esq., C.I.E., B.Sc., I.E.S.,
Director of Public Instruction, Bombay Presidency.
Dr. T. S. Wheeler, B.Sc., F.I.C., Ph.D., F.R.C.Sc.I., A.M.I. Chem.Eng.,
Principal, The Royal Institute of Science, Bombay.

Local Secretaries:

BOMBAY

Major S. L. Bhatia, M.C., M.A., M.D., B.Ch. M.R.C.P., F.C.P.S., I.M.S.,
Dean of the Grant Medical College, Bombay.
Professor P. R. Awati, B.A., D.I.C., I.E.S.,
Professor of Zoology, The Royal Institute of Science, Bombay.

POONA

V. V. Sohoni, Esq., B. A., M. Sc.,
Meteorologist, Meteorological Office, Poona.
Dr. D. D. Karve, M. Sc., A. I. I. Sc.; Ph. D.,
Professor of Chemistry, Fergusson College, Poona.

Editors:

BOMBAY

Professor G. R. Paranjpe, M. Sc., A. I. I. Sc., I. E. S.,
Professor of Physics, The Royal Institute of Science, Bombay.

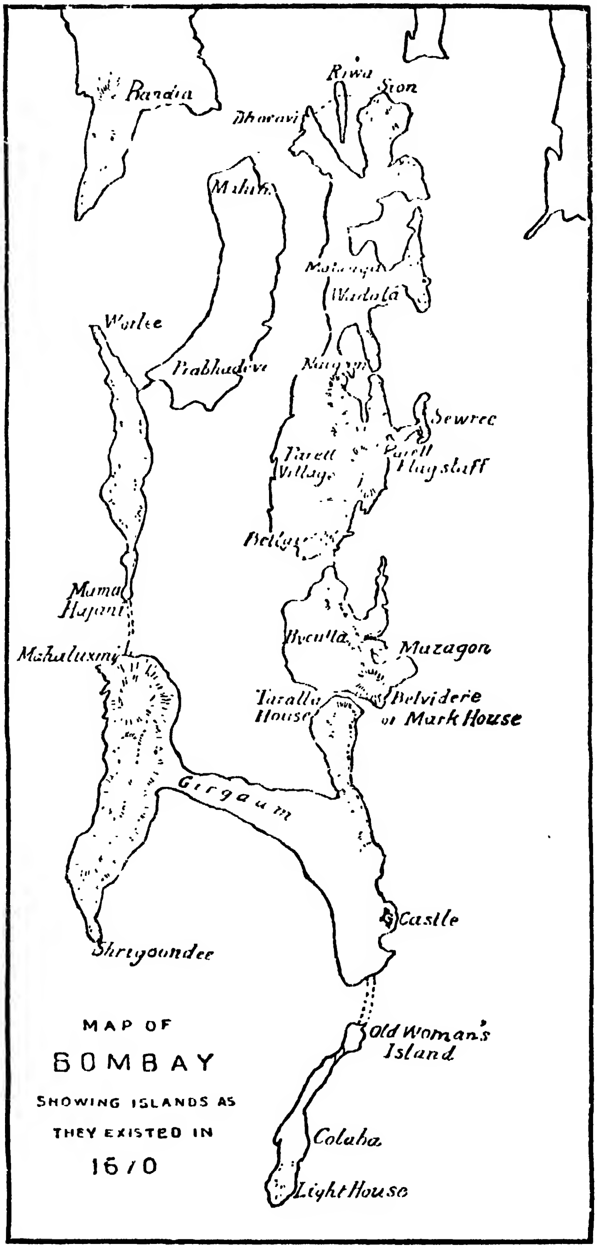
POONA

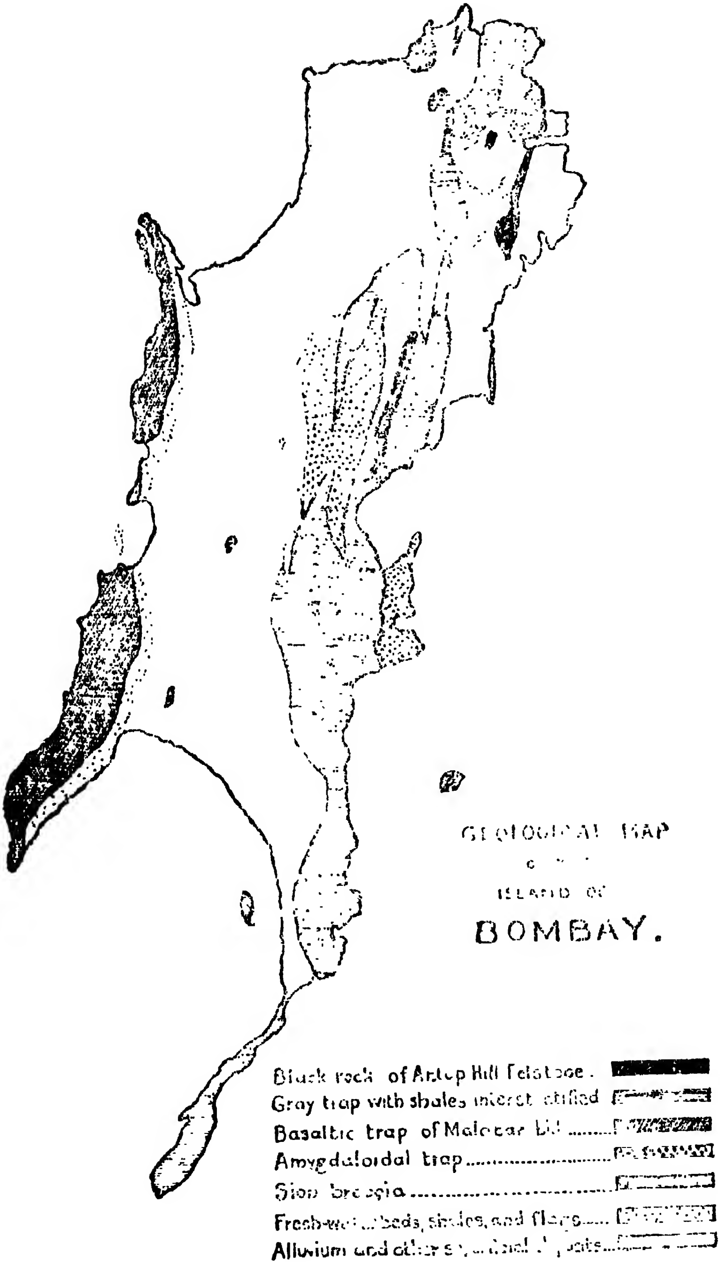
M. R. Paranjpe, Esq., M. A., B. Sc., 520 Narayan Peth, Poona.

Past Presidents:

1914	*Calcutta*	The Hon'ble Justice Sir Ashutosh Mukerji, Kt., C.S.I., M.A., D.L., F.A.S.B.
1915	*Madras*	Major-General W. B. Bannerman, C.S.I., M.D., D.Sc., F.R.S.
1916	*Lucknow*	Colonel Sir Sydney Burrard, K.C.S.I., F.A.S.B., F.R.S., R.E.
1917	*Bangalore*	Sir Alfred Gibbs Bourne, K.C.I.E., D.Sc., F.R.S.
1918	*Lahore*	Dr. Gilbert T. Walker, C.S.I., M.A., F.R.S.
1919	*Bombay*	Lieut. Col. Sir Leonard Rogers, Kt., C.I.E., M.D., B.S., F.R.C.P., F.R.C.S., F.R.S., F.A.S.B., I.M.S.,
1920	*Nagpur*	Sir Prafulla Chandra Ray, Kt., C.I.E., Ph.D., D.Sc., F.A.S.B.
1921	*Calcutta*	The Hon'ble Sir Rajendra Nath Mukerjee, K.C.I.E.
1922	*Madras*	C. S. Middlemiss, Esq., C.I.E., F.R.S.
1923	*Lucknow*	Sir M. Visweswarayya, K.C.S.I.
1924	*Bangalore*	Dr. N. Annandale, F.R.S.
1925	*Benares*	Dr. M. O. Forster, F.R.S.
1926	*Bombay*	A. Howard. Esq., C.I.E., M.A.
1927	*Lahore*	Sir J. C. Bose, Kt., C.S.I., C.I.E., D.Sc., F.R.S.
1928	*Calcutta*	Dr. J. L. Simonsen, D.Sc., F.I.C., F.A.S.B.
1929	*Madras*	Sir C. V. Raman. Kt., M.A., D.Sc., F.R.S., F.A.S.B
1930	*Allahabad*	Col. S. R. Christophers, C.I.E., O.B.E., K.H.P., F.R.S., F.A.S.B.
1931	*Nagpur*	Lt. Col. R. B. Seymour Sewell, M.A., Sc.D., (Cantab.), M.R.C.S., L.R.C.P., F.L.S., F.Z.S., I.M.S., F.A.S.B.
1932	*Bangalore*	Rai Bahadur Lala Shiv Ram Kashyap, B.A., M.Sc., I.E.S.
1933	*Patna*	L. L. Fermor, Esq. O.B.E., D.Sc. (London), A.R.S.M., F.G.S., M. Inst. M.M., F.A.S.B.
1934	*Bombay*	Dr. Meghnad Saha, D.Sc., F.R.S., F.A.S.B.

CONTENTS


Randia
Riwa
Sion
Dharavi
Mahim
Wadala
Worlee
Prabhadevi
Sewree
Parell Village
Parell Flagstaff
Mama Hajani
Mahaluxmi
Byculla
Muzagon
Belvidere or Mark House
Girgaum
Castle
Shrigoondee
Old Woman's Island
Colaba
Light House
MAP OF
BOMBAY
SHOWING ISLANDS AS
THEY EXISTED IN
1670


BOMBAY.
Gray trap with shales interstratified
Amygdaloidal trap
Sion breccia

destroyed during one of the raids on Bombay either by Mubarak or the Portuguese. In 1672 Dr. Fryer spoke of it as the "remains of a stupendous Pagoda" and according to Moore "the remains of a rather elegant temple" still existed at Malbar Point early in the 19th century. A temple built about the same period (1060 A. D.) still exists in a fair state of preservation at Ambarnath in Thana District.

About the year 1260 Raja Bimbdev, driven out of the kingdom in the Deccan by the Muhammadans under Allauddin Khilji, came over to these islands and founded a city called Mahikawati, the present Mahim. There he built a palace for himself and a temple to his family Goddess Prabhāvati—probably where the temple of Prabhāvati now stands—and a Court of Justice, His numerous retainers and followers who were chiefly Prabhus, Palshikar Brāhmans and Pānchkalshis came with him and settled in the neighbourhood of Mahim. In 1348, however, the islands of Salsette and Mahim were attacked by a Muhammadan army from Gujarat. Nāgardev, the ruler of Mahim, happened to be away at Walkeshwar when the place was invaded. His Rani, however, offered a most heroic defence, but was defeated and killed; the city was looted and Nāgardev, while coming to her assistance, was also attacked and killed in a fight near Byculla, and Bombay passed into the hands of the Sultan of Gujarat. The Muhammadan rule lasted from 1348 to 1534. The Sultans established a military outpost at Mahim, and it was during this period that the well-known shrine was built at Mahim for Makhtum Fakih Ali Paru, an Arab Pir or saint who died there in 1431. The Muhammadan rule, however, was only nominal, for the real administrative powers were in the hands of tributary Hindu Chieftains.

The Portuguese came to India towards the end of the fifteenth century, soon became masters of the Indian Ocean, and in 1510 took Goa. In 1534 they seized Bassein and forced Bahadurshah, Sultan of Gujarat, to bequeath to the King of Portugal and his heirs, for ever, the city of Bassein, its territories, islands and seas. The Bombay islands thus passed from Muhammadans to Christians. The Portuguese divided the islands into manors or fiefs which were granted as rewards to deserving individuals who in turn were bound to furnish military

assistance to the King of Portugal in times of necessity, while to the various religious orders the land was given free for ever.

One of the first lessees of "Mombaim" or "Bombaim", as Bombay was then called, was the celebrated Portuguese physician and botanist Garcia da Orta, the author of "Colloquies on the Drugs of India". He paid an annual quit-rent of £ 85 for it and lived in the "Quinta" or Manor House built sometime in the sixteenth century and which stood upon the site of the present Arsenal behind the Town Hall. It contained a fine library of historical, philosophical and medical works, and was surrounded by "a delicate garden voiced to be the pleasantest in India". It was partially burnt by the Dutch and English in 1626, but still remained standing in a more or less dilapidated condition in 1665, when Donna Ignez de Miranda, the proprietress of the Manor of Bombay handed it over to the British representative Humphrey Cooke. In the case of the various Roman Catholic religious orders, the land, chiefly in the northern parts of the island was, as stated before, freely given them for ever. Thus Franciscans and Jesuits were able to build several churches, notably those of N. S. de Esperanca on the Esplanade, now destroyed, San Miguel at Mahim, N. S. da Salvacao at Dadar, and one at Parel, which is now the Bombay Bacteriological Laboratory (Haffkine Institute), but the name of whose patron saint is not known.

In the meantime the English merchants who had settled in Surat were already coveting Bombay. As early as 1652 their Council had urged the Directors of the East India Company to purchase it, and the Directors in their turn had pressed upon Oliver Cromwell the strategic importance of the island and the excellence of its harbour.

The 23rd of June 1661 stands out as an all-important date in the annals of Bombay. For on that date was signed at the Palace of Whitehall in London the Marriage Treaty between Charles II of Great Britain and Catherine Braganza of Portugal, whereby the Princess brought with her as part of her dowry "the Port and Islands of Bombay and all the rights, profits, territories, and appurtenances thereunto belonging," and which were to be handed over to "the King of Great Britain, his heirs and successors for ever". There was also a secret article in

the Treaty by which the King of England guaranteed the Portuguese possessions in India and undertook to act as mediator between the Portuguese and the Dutch. The cession of Bombay was bitterly opposed by the Portuguese in India, and it was not until 1665 that Humphrey Cooke acquired actual possession of the island and in token thereof "took in his hand earth and stones and walked upon the bastions of the Bombay Castle". The various religious orders, however, still retained their hold upon the northern portion of the island declaring that it was their private property, and it was only through the vigorous action of Humphery Cooke and his successors that Mahim, Sion and Parel were forcibly taken and incorporated with Bombay proper.

The authorities in England, however, seemed to possess very vague ideas about the size and situation of the "poor little island". Even the Prime Minister, the Earl of Clarendon, imagined that the "Island of Bombay with the town and castle thereon" was a vast territory which was "within a very little distance from Brazil". At the time of the cession the revenues of Bombay were very small and derived from cocoanut and date palms growing between the Esplanade and Malabar Hill and at Mahim, and also from paddy fields on the low-lying grounds. The rest of the island was swampy, barren and uncultivated. The population which was estimated at 10,000 was chiefly composed of "outcastes" and "fugitives and vagabonds"; but it must be said, that there was among them a small industrial element composed of fisher-folks and husbandmen with a sprinkling of Prabhus, Brahmans and Muhammadans.

In 1668 Bombay was transferred under a Royal Charter from the Crown to the East India Company, and thenceforward it was to be held "in free and common socage as if the manor of East Greenwich" at a farm rent of £ 10 payable annually also it was to be made into a port, and immigration was to be encouraged. Sir George Oxenden was the first Governor of Bombay under the Company's rule, but he never resided there for any length of time. It was under his successor Gerald Aungier that "Bombay became the established seat of the Company's rule, and the rest of the factories in Western India, including Surat, were placed in subjection to it". This great and wise

Governor may be said to be the real founder of the modern Bombay about which he then spoke as "the city which by God's assistance is intended to be built". He strengthened its defences, settled the land revenue, established law courts, founded a mint and coined the first rupee, built a small hospital, created punchayats, opened a printing press, and secured the freedom of trade and worship to all comers; in short, "he set himself to weld into one homogeneous mass the discordant materials of Asiatic nationalities, so that a great multitude of men of diverse religions and races should live together in peace and harmony free from discord within and aggression from without, and he did it". By means of these measures the population of Bombay increased to 50 000 and among the most important of the new settlers were Banias, Armenians and Parsis. Gerald Aungier has no monument in Bombay, except perhaps the remains of the old castle walls. He died at Surat in 1677 and lies buried there in a grave which has only been identified and named within the last few years. Byron's lines to Florence for her neglect of Dante may with equal force be applied to Bombay for her treatment of Aungier.

Unfortunately in the last quarter of the seventeenth century partly through the silting up of the creeks that separated the component islands, and partly through defective sanitary conditions, Bombay, "one of the pleasantest spots in India seemed no more than a parish grave-yard". In 1689 it was "nought but a charnel-house in which two monsoons were the age of a man". The chief diseases were "fluxes, dropsy, scurvy, barbiers or the loss of the use of hands and feet gout, stone, malignant and putrid fevers"; plague, and "mordexin" (cholera) were also very prevalent. In 1706, Governor Waite wrote, "we are only eight including the Council and but two that write . . . . and most of us sick on this unhealthful depopulated and ruined island"; and in response the Court of Directors despatched Surgeons on the munificent salary of 45 shillings per month with medicines which deteriorated on the voyage! In 1718 the population had dwindled to 16,000. The high mortality was attributed to three causes: (1) "pestilential deposits" on account of the silting up of the creeks, (2) manuring of toddy palms with putrid fish, and (3) dissolute living. In spite of

all these drawbacks, and the unwelcome visits of the Siddi admirals and pirates, the work of the town defences was pushed on; in 1716 the town walls were completed and the place made more secure, and as a consequence, settlers again began to come in.

In 1736 the dockyard was extended under the supervision of Lowji Nusserwanji Wadia, a Parsi shipuilder from Surat, and the defences of the town were further strengthened in 1744-48 and again in 1756-63. Sanitation was improved, a "Town Scavenger" was appointed, building laws were promulgated, and by 1744 the population increased to 70,000. In 1750 and 1756 more docks were opened and the number of trading vessels consequently increased. About the year 1770 the extension of the town was taken in hand, crowded and insanitary houses were demolished, the Esplanade was extended and levelled and every encouragement was given to the inhabitants to build their dwellings outside the Fort. In 1780 it was found that the population had increased so nearly 114,000. About this time the Company obtained Salsette and the adjoining islands in the harbour. The Vellard was constructed by Governor Hornby about 1784; it completely shut out the sea and prevented it from coming in and inundating the central portion of the island; the low lying "flats" were thus rendered available for cultivation and settlement.

In 1800 the Governor Hornby's house in the Fort-the former Great Western Hotel—was made into a Court House where Sir James Mackintosh, a great scholar and judge, sat and decided civil and criminal cases. In 1803 a severe famine occurred in the Konkan and Deccan, and it brought a number of people to seek employment in Bombay. The same year a great fire destroyed a number of houses in the Fort, but it enabled Government to construct wider thoroughfares in the most congested parts of that locality; it also acted as a general incentive to the residents to build houses, shops and godowns outside the city walls. In 1814 the population had increased to 180,000.

In 1818 with the defeat of the Peshwa at Kirkee, the Company annexed the Deccan, and in the succeeding years under the regimes of Mountstuart Elphinstone and Sir Bartle Frere, Bombay developed its trade with the mainland to a considerable extent. In 1830 Bhore Ghat road to Poona was opened, and in

1838 a regular monthly mail service to England was established. About this time considerable attention was paid to improving the sanitation of Bombay; the "flats" were reclaimed, Colaba island joined by a causeway to the Fort, an adequate water supply was provided and the city carefully drained. The present Mint was built in 1827 and the Town Hall completed in 1833.

In 1858 after the Mutiny, Bombay reverted to the Crown. The G. I. P. Railway which had run its first train in 1853 from Bombay to Thana, a distance of 20 miles, constructed the Bhore Ghat line in 1863. By 1860 Bombay became a great cotton market of Western and Central India, and its cotton trade increased to an enormous extent between 1861 and 1865 on account of the outbreak of the Civil War in America; and during that time Bombay benefited to the extent of about 81 millions sterling owing to the cotton trade being diverted to it from America. But when the American War ended, the price of cotton fell at once, a crash came, and there were numerous failures; the commercial stability of the city however suffered no permanent damage. The modern Bombay may be said to be built up and established during these years; for it was during this period that those great engineering and reclamation schemes were formulated which have given this city the magnificent public buildings facing the Back Bay, Dockyards and Light-houses, the Elphinstone Circle, the Railway Workshops, and the European General Hospital. The Government freely aided private enterprise in the task of improving and beautifying the island; room was made for many of these improvements by the demolition of the city walls. About this time also the gas-works were constructed and the city lighted with coal gas.

The progress of the city has since then gone on by leaps and bounds. In 1875 King Edward visited Bombay, as Prince of Wales and laid the foundation stone of the Prince's Dock. Since then extensive schemes of reclamation and other progressive measures have been carried out. With the invasion of plague the City Improvement Trust was created for the purpose of demolishing the insanitary areas and opening out the congested districts. With Tata's Hydro-electric scheme, electric-mains have been laid and electricity is now available all over the city for practical purposes, *viz.*, for lighting and the working

of Tramways, Mills and Railways. The reclamation of a large portion of the harbour has enabled the construction of the new and extensive Alexandra Docks and the Ballard Estate.

In 1911 Their Majesties the King-Emperor George V and Queen-Empress Mary landed in Bombay at the Apollo Bunder, and in memento thereof a superb gateway—the Gateway of India—designed by Mr. Wittet of this city in pure Hindu architecture, is erected at the place of their landing.

DESCRIPTION

Old local documents and the statements of early European writers have conclusively proved that Bombay originally consisted of seven separate islands (see Map). These, partly by the silting action of the sea, and partly by the human agency have now been made into one island (see Map) which is 11½ miles long, 3 to 4 miles broad; it is flanked by two parallel ridges of low hills, of which the eastern is the longer and ends in the sea at Colaba, while the other ridge runs along the west of the island and terminates in Malabar point; between the two lies the shallow expanse of the sea, known as the Back Bay. The harbour lies to the east of the island of Bombay, between it and the mainland of the Deccan.

On a strip of land between the Back Bay and the harbour is situated the Fort, the original nucleus around which the city has gradually developed; it is now chiefly occupied by Government Offices, public buildings, business houses and shops. The termini of the G. I. P. Ry. and B. B. & C. I. Ry. Local are also situated in this part of the city. To the north of the Fort is the " Bazaar " with houses rising from three and four even to six storeys in height, " some with elaborately carved pillars and front work. " To the west is Malabar Hill, a fashionable locality from which a magnificent view of Back Bay and the town can be obtained. At the extreme point of Malabar Hill is Government House, while at the other end of Back Bay is Colaba Point with the Prong's light-house beyond. To the north of Malabar Hill, and its continuation, Cumballa Hill, is an embankment known as the Hornby Vellard which joins Cumballa Hill to Worli. Before its construction the central part of the island, on account of its low-lying position, was

liable to be sub-merged at high tide. Now however, this district forms the most important industrial part of the city. To the east is the hill of Mazgaon, upon which, in early days, stood a whitewashed house which used to serve as a guide for vessels entering the harbour. It was once the residence of Sterne's Eliza (Mrs. Draper) and was known as Belvedere House ; it was demolished about 1864.

The northern part of the island consists of the districts of Mahim, Parel and Sion and still contains some marshy land. Mahim, which in ancient times was a flourishing island under Raja Bimbdev, is now a thickly wooded palm grove ; it is connected with Bandra by a causeway which is a continuation of the Lady Jamsetjee Road. In the District of Parel is situated the Bombay Bacteriological Laboratory (now Haffkine Institute). which in olden times was the official residence of the Governors of Bombay. To the extreme north is the district of Sion (derived from the Marathi "Simā, " a boundary or limit) which is connected with the island of Salsette by the Sion Causeway built by Governor Duncan in 1805. The old causeway has lately been considerably widened by reclamation, and replaced by a magnificent carriage road.

These different parts of the islands are connected by the G. I. P. and B. B. & C. I. Railways which provide an ample service of local trains. There is an extensive net work of Electric Tram Car Service, and in addition to that taxi-cabs. buses and hack victorias can also be engaged; their tariff is fixed.

The principal Buildings and Hotels are situated in the Fort. The enormous Taj Mahal Hotel is a conspicuous structure along the Apollo Bunder ; in the vicinity are the Apollo Hotel and Hotel Majestic, and a little further north insted of the Esplanade and Great Western Hotels, now stands the Grand Hotel.

The *Apollo Bunder* originally constructed by General Bellasis was until recently the landing place for overseas passengers. it was decided to erect thereon a large archway to be called " The Gateway of India " in commemoration of the landing of King George V and Queen Mary on the 2nd of December 1911. The Arch was completed and opened by the Viceroy in 1924. An extensive view of Bombay harbour, its islands and of the distant

hills of the Western Ghats can be obtained from this spot Along the Bunder Road and overlooking the harbour is the *Royal Bombay Yacht Club* with residential chambers on the opposite side. Further on is the Sailors' Home, constructed at the expense of a former Gaekwar of Baroda, and used almost entirely for some years as naval barracks, is now with an additional building the Legislative Council Hall and Offices In the open space in front is the *Weillington Fountain* which was erected in memory of the Duke of Wellington who once resided on this island. In the crescent shaped area to the north is the *Prince of Wales' Museum of Western India.* A statue of King George V in naval uniform stands in the compound. The Regal Theatre is to the southwest and to the west of the museum building are *Elphinstone College*, *Law College*, and commencing from the latter and curving westward is an extensive pile of buildings, the *Royal Institute of Science* with its magnificent public hall, the gift of Sir Cowasji Jehangir. It is in this building and in the University buildings that the 21st session of the Indian Science Congress is to be held. Here stands the statue of the Prince of Wales near the *Band Stand*. To the south is the Cooperage on which in old days was situated a shed for storing " King's provisions " and hence the name. In the vicinity are the *Admiral's House, the Princess Mary, Japanese and Commercial Gymkhanas* and Swimming baths. Further south is the *Cuffe Parade* reclamation, and beyond it lies *Colaba* with the Afghan Memorial Church Military barracks, Station Hospital, and the Colaba Observatory, one of the chief meteorological and seismological stations for Western India.

To the north of the Royal Institute of Science, and situated along Mayo Road there is a long row of magnificent public buildings. The first is the *Secretariat*, the office of the Secretaries to Government. This Venetian Gothic building which was completed in 1874, formerly contained the Council Hall on the first floor. To the north of the Secretariat is the *University Senate House* or Convocation Hall where University degrees are conferred. The building is in decorative French-Gothic style and has in the gable a large circular window embellished with the twelve signs of the Zodiac in stained glass. The next building is the *University Library* and *Rajabai Clock Tower*. The Tower, which is the gift of the late Mr. Premchand Roychand of this

city, 250 ft. high, and forms a very conspicuous land-mark not only from Malabar Hill, but also from across the harbour, and even from steamers when out in the Arabian Sea. Both these buildings were designed by Sir Gilbert Scott, R. A. To the north and the south of the main University Buildings are the additional buildings which provide accommodation for the University Offices and Meeting rooms, Examination Halls, School of Economics and Sociology and the Head-Quarters of the University Training Crops. To the north of the University Buildings is the *High Court*, a huge pile in early English-Gothic style with the figures of Justice and Mercy near the central tower. Further north is the *Public Works Secretariat* and beyond it is the *Telegraph Office*. The large open space in front of all these buildings, known as the "Oval" on account of its shape, is often utilized for holding sports. To the north of the Oval and opposite Churchgate Street Station are the *Offices of the B. B. & C. I. Railway*, a Gothic structure with Indo-Saracenic domes ; the central gable of the west facade is surmounted by a group of figures by Roscoe Mullins representing "Engineering". Further along Mayo Road in the open space is a fine *statue of Queen Victoria* by Noble under a beautiful canopy of Gothic design. In the vicinity are the Offices of the *Improvement Trust*, *Bombay Gymkhana* and the residence of *Sir Dorab Tata*. Passing between the Public Works Secretariat and the Telegraph Offices is Churchgate Street and where it joins Esplanade Road, there is an open space with a fountain erected in honour of Sir Bartle Frere and known as the *Flora Fountain*. Near this spot, when the city had its fortifications around it, stood the western gate of the ramparts, *viz.*, the Churchgate. From this place Hornby Road runs to the north and Esplanade Road to the south, the chief shops and banking houses are situated in these roads. Churchgate Street ends towards the east in *Elphinstone Circle* in the neighbourhood of which there are some old buildings : *St. Thomas Cathedral* (*1718*). *The Mint* (*1824*), and the *Town Hall* (*1838*). The Elphinstone Circle houses were built about the year 1865. Behind the Town Hall is the Arsenal—a relic of Old Bombay—the old Portuguese Fort, which still retains the ancient fortifications. To the north of the Mint are the offices of the *Bombay Port Trust* and close by, the reclamation for the Alexandra Docks. At the entrance to the re-

clamation stands the New Custom House and at the end of the mole a railway station. Even large steamers can now touch the dock-wall and up-country passengers can entrain direct to their destination. This place is known as the Ballard Pier.

Hornby Road, a little to the north, joins Cruickshank Road, and here in the open space stands *Victoria Station*, the terminus of the Great Indian Peninsula Railway, and said to be one of the most beautiful Railway Stations in the world. It stands on the original site of the old temple of Mumbadevi, the patron Goddess of the island. To the east is the *Post Office*, a handsome pile of Indo-Saracenic architecture. Behind it lies *St. George's Hospital* for Europeans, and in the compound a portion of the old wall of Fort George which formerly stood there, can still be seen. Opposite the Post Office, near Bazaar Gate Police Station, stood the old Bazaar Gate of the ancient ramparts. Facing Victoria Terminus are the *Municipal Offices*, the foundation stone of which was laid by Lord Ripon in 1884. *The Masonic Hall* in Ravelin Street, and *Excelsior Theatre* are also in this vicinity. To the west is an extensive open space known as the *Esplanade*. Here in former times stood one of the oldest Portuguese churches in Bombay, *viz*, that of Nossa Senhora da Esperanca, Our Lady of Hope, which had to be razed to the ground in 1760 as it came in the way of the guns of the fort ramparts. The place is now marked by a cross which stands near the barracks of the old Marine Battalion. In the Vicinity is the *Marine Lines Hospital* for Indian Soldiers, and to the west, facing the Queen's Road, are quarters for Military Officers. Along the continuation of Hornby Road northward, beyond the *Times of India* Building, is the *Sir J. J. School of Art*: further on are the *Sydenham College of Commerce*, the *Police Head Quarters*, and to the east the *Crawford Market* named after Mr. Arthur Crawford, who held the post of Municipal Commissioner from 1865 to 1871. Along Cruickshank Road commencing from the Municipal office will be seen the *Police Courts*, the *Allbless and Cama Hospitals* for women and children. *St. Xavier's College*, *Elphinstone High School* and the *Secondary Teachers' Training College*. Esplanade Cross Road begins here and runs eastward as Carnac Road along which are *St. Xavier's School* with a tower 120 feet in height, *Gokuldas Tejpal Hospital* and the *Police Offices*.

The City proper lies to the north of the Esplanade Cross Road. The continuations of Esplanade and Hornby Road, *viz.*, Kalbadevi Road and Abdul Rehman Street respectively, meet ultimately at Pydhowni or the "foot-washing place" where in olden times the sea used to come in and in which the passers by used to wash the dust from their feet. In this part of the city are situated the *Roman Catholic Cathedral*, (Our Lady of Hope), erected in place of the old church on the Esplanade, the *Mumbadevi Temple* of the Hindus which replaces the original temple of the patron goddess of the island, and the *Juma Masjid* of the Muhammadans. Moreover the cloth and silver markets are also situated in this locality. Further north is the old Jail built in 1804, and a little beyond are the extensive grounds occupied by the *Jamsetjee Jeejeebhoy Hospital, the Cowasji Jahangir Opthalmic Hospital, Bai Motlabai Obstetric Hospital* the *Petit Hospital* for women and children, the *Byramjee Jeejeebhoy Hospital* for children and a large residential hostel for medical students. These are the chief Hospitals for clinical medical instruction in Western India and attached to them is the teaching institution, the *Grant Medical College*, named after Governor Grant and opened in 1845. The *F. D. Petit Laboratory* for research work and the newly built *Physiological and Pathological Laboratories* and the Government Chemical Analyser's Office and Laboratory are also situated in the same compound. The *Northcote Police Hospital* is close by and further west is *Byculla Club*. Further west is the new Terminal Station of the B. B. & C. I. Railway and known as the *Bombay Central*.

The wide carriage drive which skirts Back Bay is known as Queen's Road (See Map). Commencing at the B. B. & C. I. Railway Office, it passes The *Bombay Presidency Radio Club*, the Head-quarters of the *Western India Automobile Association*, the *Bombay Brigade Office*, and Military Officers' quarters, the railway line running parallel to it on the west. Further on, the road passes by the *Hindu Burning Ground*, the *Muhammadan Burial Place*, and a disused *Christian Cemetery*. In olden times the sea used to come quite close to these cemeteries which were situated on the sandy beach of Back Bay. Queen's Road then passes by the *Royal Opera House* over the Sandhurst Bridge

where it divides into Chowpaty and Hughes Roads. The former runs along Back Bay, and as Walkeshwar Road passes up Malabar Hill, by the lower entrance gate of Government House compound, and a little further up joins Ridge Road. Walkeshwar Road then passes Walkeshwar temple, which lies to the right, and ultimately ends at the upper gate of the Government House Grounds. *Government House* itself is situated at the extreme point of Malabar Hill and consists of a number of small marine villas. Ridge Road runs northward practically along the top of the Hill between fashionable residences to the *Malabar Hill Reservoir* and the *Pherojshah Mehta Gardens*, from which a magnificent view of Back Bay, the southern part of the city, the harbour and its islands and even the mainland of the northern Konkan beyond, can be obtained. The road then passes further north as Gibbs Road with the Parsi *Towers of Silence* to the left and the Hindu *Temple of Babulnath* to the right, until it joins Hughes Road near the *Parsi War Memorial*. A turn should here be taken to the left which brings one to Warden Road which passes by the *Mahaluxmi Battery*, the *Parsi General Hospital*, the *Swimming Bath*, and the *Mahaluxmi Temple* until it reaches *Hornby Vellard*. The Vellard which was built by Governor Hornby effectually checked the inroad of the sea at the place and by reclamation rendered available for cultivation and settlement a wide area of low-lying land to the east, and "welded the eastern and western shores of the island into one united area". At the southern end of the Vellard, out in the sea can be seen the *Darga of Haji Ali*—a Muhammadan Pir; it can be visited only during low tide. At the further end of the Vellard is the palace *Samudra Mahal* of H. H. Maharaja Scindia and close to it is the tomb of *Mama Hajani*, another Muhammadan Pir, sister of Haji Ali. The road then passes on to Worli by the *Love Grove Pumping Station* where the major portion of the sewage of Bombay is pumped out into the sea by means of very powerful machinery. To the east of the Vellard are the *Willingdon Sports Club* with its extensive grounds, and the *Race Course*. To the north and east lies the industrial centre of Bombay with its innumerable chimneys. To the east is *Jacob's Circle* where seven roads meet from different parts of Bombay. A handsome drinking fountain in memory of General Legrand Jacob ornaments the centre of the circle. Further east is the

Victoria Gardens which contain the Victoria and Albert Museum, a well- laid-out botanical garden, and a collection of wild animals and birds. In the vicinity is the *Maratha Hospital* for plague, and near Jacob's Circle are the *Arthur Road Hospital* for Infectious Diseases, and the *Prison*.

Further north in Parel district is the *Bombay Bacteriological Laboratory*, now known as the Haffkine Institute, a large building which in former times was the residence of the Governors of Bombay. Close to it are the *King Edward VII Memorial Hospital* and the *Seth Gordhandas Sunderdas Medical College* with all its museums, laboratories and a students' hostel. The *Wadia Maternity and Children's Hospital* and the *Haji Bachoo Ali Opthalmic Hospital* are in the neighbourhood.

To the east beyond Godanji Hill is *Sewri Cemetery* which in olden days was the site of the Agri-horticultural Society's Garden. Further north is the *Acworth Leper Asylum*, with a beautiful garden, a sewage installation and a sewage farm which are well worth a visit. Vincent Road passes through the middle of this part of the island and is the main road which leads from Bombay to the mainland.

To the north of the Vellard is Worli, now a fishing village but which had formerly a fort of its own. An excellent beach with a promenade is now built at this place. The largest number of cement chawls, built by the Bombay Development for providing housing accommodation to mill-hands, are found in this region. To the northeast is Mahim which in ancient times was a flourishing island named Mahikāwati under Raja Bimb; there is no trace left now of its ancient greatness, but its old temple Prabhādevi (but not the original one) is still in existence. This district shows a thick cultivation of cocoanut palms, known as *Mahim Woods*. In the northern part of Mahim there is an old shrine, in which a Muhammadan Pir named *Makhtum Shah* was buried in the fourteenth century. Mahim has also two old Portuguese churches, *viz.*, that of Nossa Senhora da Salvacao, Our Lady of Salvation and that of San Miguel; the latter stands at the end of Lady Jamsetji Road, while on the opposite side of the road is the *Mahim Fort*. Mahim is connected with Bandra by the *Lady Jamsetji Causeway*, and with Sion by a very tortuous old narrow road which passes through a marshy locality known as *Dharavi*

The Tannery of the Western India Boot and Equipment Factory is located in this district. At Sion there used to be an old fort where the Commandant of the Militia used to reside. Sion is joined to the mainland by a magnificent carriage road which lies to the west of the G. I. P. Railway line. It has been made by reclamation, and it replaces the old *Duncan's Causeway*. A very large road has now been constructed through the city and from Byculla it passes through Lal-Bagh, Parel and Dadar. Further on it is known as the King's Way and goes upto the *King's Circle* at Matunga. Half-way on this road, to the right, going northward, are the new premises of the *Victoria Jubilee Technical Institute* and the *Technological Laboratories of the Indian Central Cotton Committee.*

On modern principles of town planning, new and elegant suburbs are developed at Dadar, Matunga, Khar, Chembur, Santa Cruz and various other parts in the northern districts of Bombay. The localities are generally very clean and healthy, are provided with broad asphalt roads and are lighted by electricity. Most of the houses in these areas are either private houses or built by various Co-operative Housing Societies and they are usually self-contained blocks for middle class families. It is very interesting to note that almost all the improvement has been achieved during the last decade or so.

POPULATION

The following figures are interesting and show the progressive increase of the population of Bombay, and how the little island of "outcastes" and "fugitives and vagabonds" has within 260 years risen to be "the Second City in the Empire":—

Year.					Population
1668	...	..	...	...	10,000
1744	...	...	...	...	70,000
1780	...	...	...	...	113,726
1814	...	...	...	...	180,000
1836	...	...	...	...	236,000
1846	.	...	...	...	566,119
1864	..	...	...	...	816,562
1872	...	...	...	...	644,405
1881	...	..	.	...	773,196

Year	Population
1891	821,764
1901	776.006
1906	977,822
1911	979,445
1921	1.175,914
1931	1,161,383

According to Religions the population of 1931 was as follows:

Hindus	789,861
Mussalmans	209,246
Christians	80,728
Zoroastrians	57,765
Jains	12,424
Jews	8,621
Sikh	985
Other religions...	1.753
Total ...	1,161,383

CLIMATOLOGY

The climate of Bombay may be generally defined as fairly equable. Neither the variation of temperature from month to month, nor the fluctuations which occur from day to day are by any means large. The daily 'variability' of temperature which has a marked influence on organic life is fairly small, a result mainly due to the proximity of the sea and the presence of large quantities of aqueous vapour in the atmosphere. This however renders the climate even during the winter months relaxing rather than invigorating, and during the summer months strangers are apt on that account to denounce it as that of a Turkish bath. The prevalence during the winter months of the comparatively cold dry east winds brings no advantage as the winds blow over the land and can hardly be so fresh and free from germs of diseases as those which come from over the sea.

The divisions of the year into the seasons is appropriately made into two—the dry and the wet monsoon seasons. These are determined by the great systems of wind, the north-east and the south-west monsoons which prevail alternately during the year from October to April and May to September respectively over

a wide area including the continent of India and the Indian Ocean.

The mean annual temperature is 79°.6. The fluctuations in the annual means do not exceed 1°.4 at the outset. The greatest maximum temperature 81°.0 was recorded in the year 1865 and the lowest minimum 78°.3 in 1866 and 1874. The mean variability of the annual mean is 0°.5 May is the warmest month in the year with a mean temperature of 84°.7. While for January which is the coldest month the mean temperature is 73°.9. The seasonal variation of temperature which until May follows fairly closely the course of the Sun and varies with the zenith distance is interrupted by the gradually growing intensity of the south-west monsoon current and the upward tendency being arrested the temperature from July to October continues almost within 1°.6 of the mean of the year, and the daily range also is markedly reduced. A slight rise in October is recorded after the recession of the monsoon current after which the march of the temperature duly follows the season. It falls till January and begins to rise thereafter till May or June. The extreme maximum temperature recorded for the month of January was 77°.3 in 1865, while the extreme minimum was 71°.1 in 1874. The notable maximum mean temperature for the month of May—the hottest month in the year— was 87°.6 in 1865, the minimum recorded being 8?°7 in 1866. The coldest time of the day is about sunrise, 6 a.m., and the warmest at about 2 p. m. The periodic diurnal range is greatest in December and January when it is about 10°.7 and least in July when it is only 2°.9. The average daily variability during the year is 0°.76. It is 0°.96 in June and 0°.88 and 0°.84 in January and February. This change of temperature from day to day is least in May about 0°.42 which is generally the healthiest month in the year. The average annual rainfall at Colaba is 71.06 inches. The maximum fall recorded is 114·89 inches in 1849. The record minimum falls being 35.90, 33.42, 33.36 and 35.51 inches in 1899, 1904, 1905 and 1918 respectively.

The average date of the arrival of the monsoon on the Bombay coast is 6th June. The extreme limiting dates between which the earliest beginning and the latest ending of the south-west monsoon current are likely to fall may be definitely laid

down as the 1st May and 27th October. If a day is considered as a rainless day when less than one cent has been registered, the ratio of rainy days to the total number of days in the month may be taken roughly to express the probability of a day being rainy in that month. On the average this probability in June, July, August, September and October is represented by .70, .90, .85, .64 and .15 or in other words out of every 10 days there is a probability of 7, 9, 8, 6 and 1 day being rainy in these months respectively. The average monthly rainfalls of these months are 19·87, 24·50, 13·15, 10·43 and 1·88 inches.

The seasonal changes in humidity show that the lowest humidity 0.668 (1.000 denoting saturation) is reached in December. It keeps fairly uniform till February and rises thereafter till July when the maximum value 0. 867 is attained. During the monsoon months this high humidity prevails steadily throughout till September. The cessation of the monsoon rains reduces this value which in October stands at 0.783 and thereafter it falls attaining its minimum value in December. The air is drier in the afternoon hours and most humid in the early morning hours. This relative difference is much less pronounced during the monsoon months. It is greatest in December when at 2 p. m. the humidity is only 0.554 and at 6 a. m. it is 0.763, while in July it is least — the respective figures being 0.841 and 0.895.

The prevailing direction of the wind is west-north-west, the oscillations of which about the mean position reach to the N. N. E. about December and to the S. W. in June. The average velocity during the year is 8·7 miles per hour. The maximum velocity is attained in July when it is about 13·8 miles per hour. It decreases steadily and attains its minimum value 6·8 in October. It rises steadily thereafter to 8·1 miles per hour in March, falls slightly in May to 7·8 and rises suddenly thereafter reaching its maximum intensity in July. The prevailing direction of incidence of the local land and sea breezes are W. N. W. and E. N. E.

N. A. F. Moos

ARCHAEOLOGICAL

The Bombay Castle.—Hidden among the trees behind the Town Hall and surrounded by old ramparts is the Bombay Castle; probably the oldest building in Bombay. It was the Manor House of Garcia da Orta, the celebrated Portuguese physician and botanist to whom "Bombaim" was rented in perpetuity in 1538. The house, which was originally built by Garcia da Orta himself, was known as Quinta and was in his time surrounded by a beautiful garden planted by the great botanist. This "Great House", which subsequently served as a Warehouse, Priory and Fort to the Portuguese, was partially burnt by the Dutch and the English in 1627, but was rebuilt and better protected and still formed the residence of the Lord of the Manor. It was again partly destroyed by the Arabs of Muscat, and when Humphrey Cooke took possession of the island from Donna Ignez de Miranda, the proprietress of the Manor of Bombay in 1665 " there was little more than the walls" left of the Manor House. It was, however, put right · Aungier rebuilt the fortifications around it, and the " Bombay Castle " then became the Governor's residence. All Government Resolutions and Orders are addressed even to this day from " Bombay Castle ". It was also known as the " Fort House " and now faces the visitor as he enters the gateway of the Old Arsenal and is marked as the " Pattern Room ". The gateway was built by the Portuguese. An interesting relic in the Castle is " a long vault high enough for a man to stand in upright, and was probably used as a dungeon. It is a perforation of some twenty feet in length ending in a dead wall: there are no air holes or light admitted except by the door ". The prisoners confined in it must have heard the sea moaning outside as in the dungeons under the Doge's Palace at Venice where one is told to listen to the waves of the Adriatic. Another interesting relic is the Sun Dial, it is ten feet high and embellished with much grotesque carving. The gnomon is gone but the figures are still distinct. It is said to be " the oldest sculptured work in Bombay belonging to the period of the Portuguese occupation ".

The City Ramparts and Fort George.—Bombay when it was ceded by the Portuguese was practically unprotected, the old Manor House being nothing but bare walls surrounded by an

equally dilapidated rampart. It was therefore in constant danger of being attacked from land as well as from the sea; the Portuguese, the Marathas, the Sidi Admirals, Angria's ships, and the Pirates John Evory and Captain Kidd constantly menaced the island. The houses of the inhabitants living outside the Castle were not surrounded by any protective rampart walls, and Aungier therefore advised the enclosure of the town from Mendham's point on the west to Dongari point on the north where a small Portuguese fort already existed. The City wall, however, was not completed until 1716. Starting from a point to the east of the bungalow of the Director of the Royal Indian Marine the wall extended along Rampart Row, then known as the "Rope-walk", and passing the Esplanade and Hornby Roads turned eastwards and stopped at Mody Bay near Fort Street. These fortifications were extended and strengthened in 1736. In 1739-1743 a ditch was constructed around these ramparts and between 1746-1760 extensive additions were made in the shape of bastions and batteries. The fortifications were still further improved in 1769 and the little Dongari Fort which until then was used as a prison for debtors and criminals was demolished and in its place Fort George was built on a large scale.

Fort George.—Fort George, named after King George III, stood outside the Bazaar Gate on a slight eminence called "Dongari", and although it was a small fortified place it overlooked the Castle proper, and was therefore strategically very important. It was demolished along with the fort ramparts (1862-1864) but the remnants of its walls may still be seen in the grounds of St. George's Hospital.

The city ramparts—if the marine gates be excluded were provided with three gates. Of these the *Apollo Gate* faced the south and stood near St. Andrew's Church. The *Church Gate* stood near the present Flora Fountain, and was the main and fashionable gate of the city. The *Bazaar Gate* stood near the north end of Bazaar Gate Street, and was the most frequented gate, being chiefly used for bringing supplies into the city.

The old ramparts of Bombay, and the city gates were demolished in 1862-64. They were found to be useless for purposes of defence, they interfered with the free circulation of air, and the ditches harboured "stagnant and foul" water. The space

thus set free was laid out in roads, open places and public buildings. No remnants of the city walls are now in existence.

The old Secretariat.– This building stood in Apollo Street on the site of the present "Sardar Palace building". Before 1757 the Governor resided in the "Fort House", but in that year Government purchased "Mr. Spencer's House" in Apollo Street and transformed it into Government House. It was described as "a handsome building with several good apartments"; Governor Jonathan Duncan died in it in 1811. In 1829 it was converted into the Secretariat, and the Governor's residence removed to Government House at Parel. It remained as Secretariat until 1874, and even after the removal of the Secretariat from it to the present new building on the Esplanade, was for a long time known as the "Old Secretariat". It was sold by Government in 1886.

Hornby House.—The Great Western Hotel Building has a historic past, but its date of building is not known. In 1754 it belonged to Mr. Hornby, who afterwards became Governor of Bombay, 1771-1784, and was consequently known as Hornby House. From 1741 to 1770 it was used as Admiralty House and from 1786 to 1880 its main room was the Town Hall. From 1786 to 1788 the Mayor's or Recorder's Court occupied a back room in the building. In 1800 the whole of Hornby House was rented for the Mayor's Court and here in the large main hall—the former dining hall of the Hotel—Sir James Mackintosh, the Recorder of Bombay, sat and decided criminal and civil cases from 1803 to 1811. In 1824 the Recorder's Court was styled the "Supreme Court", which name in 1862 was changed into "High Court" and in 1879 it was removed from Hornby House to the present High Court building on the Esplanade.

Hornby Vellard.—This causeway which is about half a mile in length unites Cumballa Hill with Worli and was constructed by Hornby during his Governorship from 1771 to 1784. At the southern end of it, out in the sea lies the tomb of Haji Ali, a Muhammadan Pir, and at the further end of the Vellard on the point of the hill near H. H. the Maharaja Scindia's Palace stands the shrine of Mama Hajiyani. There are reasons to suppose that a causeway did actually exist in this place before Hornby

constructed the present Vellard. Aungier in 1673 mentions a "breach" at Mahaluxmi "where the sea came in and inundated the island". but makes no allusion to any dam. By the gradual silting up of the creeks with highly putrescible matter deposited by the tides, the island gradually became so extremely unhealthy that when the Rev. J. Ovington, the Company's Chaplain, visited Bombay in 1689, he described it as " nought but a charnel-house ". The excessive mortality of Bombay caused the greatest anxiety to the Court of Directors who constantly urged the necessity of stopping the breaches and reclaiming the low-lying area liable to be flooded. As a result of this Captain Bates constructed about the year 1720 a dam which checked the inroads of the sea and rendered the central part of the island available for cultivation. In 1750 Grose wrote the following: " There has always been another reason assigned for the island having grown healthier from the lessening of waters by a breach of the sea being banked off ". In 1754 Edwards Ives wrote as follows: " The island of Bombay has of late been rendered much more healthy than it was formerly by a wall which is now built to prevent the encroachment of the sea where is formed a salt marsh ". The existence of such a wall is actually shown in Niebuhr's map dated 1764, *i. e.*, nearly seven years before Hornby became Governor. Moreover, Dr. Buist, the Geologist, seems to have been aware that the Vellard was built before Hornby's governorship, for he tells us in an article on the Geology of Bombay which is published in the *Transactions of the Bombay Geographical Society*, Vol. X. 1852, that " the embankment between Love Grove and Mahaluxmi was completed about a hundred years before, *i. e.*, 1752, which it is said has contributed much to the improved health of the place ". Under these circumstances the only conclusion which one can come to is that Governor Hornby only constructed a carriage road over a pre-existing dam, built nearly 50 years before his regime. The name Vellard is derived from *Vallado*, a Portuguese word, meaning an embankment. In 1747 a naval engagement took place off Hornby Vellard, " the only battle ever fought by the French and English on the western seas of India ".

The Town Hall.—The necessary funds for the erection of the Town Hall building were originally raised by means of lotteries, but the amount proving insufficient, Government were asked

to complete the work. The building was designed by Col. Cowper, R. E., and completed in 1833. A massive flight of stone steps on the west leads to a colonnade of large Doric columns which were originally intended to stand in pairs. The pediment is empty. The great main hall, the internal decorations of which are Corinthian, is used for public meetings, concerts and balls, and contains a large organ, the gift of Sir Albert Sassoon in 1872. Behind it is the "Durbar Room" which was formerly used for state purposes. The north end of the building is occupied by the *Bombay Branch of the Royal Asiatic Society* which has arisen from the Literary Society of Bombay founded by Sir James Mackintosh, Recorder of Bombay, in 1804 "for the promotion of literary and scientific investigations connected with India and the study of literature, antiquities, arts and sciences of the East". Since 1829 it has become an integral portion of the Royal Asiatic Society of Great Britain and Ireland. In 1873 the Bombay Geographical Society (established in 1831) was amalgamated with it. The Royal Asiatic Society's *Library* contains a large collection of rare old books and valuable manuscripts in Sanskrit, Prakrit and Gujarati. The *Museum* attached to the library was opened in 1816 and contains many valuable and interesting archaeological relics. The museum of the Anthropological Society of Bombay was also located in this building (see Museums), but has been since removed to the Prince of Wales Museum. A number of fine statues have been housed in the Town Hall; these have been described in detail under the heading of "Statuary".

Old Government House, Parel.—This building was originally a Roman Catholic Church, but the date of its building is not known. The earliest reference to it is by Dr. John Fryer, M. D., who described it in 1674 as a church and convent belonging to the Jesuits. But there is reason to believe that these previously stood upon the site of the Hindu Temple of Parali-Vaijnath built by the followers of Raja Bimbdev, and that it was from this temple that the district acquired its name of Parel. The temple was destroyed through the proselytizing zeal on the part of the "Religious Orders" to whom this part of Bombay was given free of rent by the Portuguese Government. Fryer makes no mention of the Patron Saint of the Church, and the actual name of the church remains unknown to this day. It seems,

however, that it was under the control of the Principal of the College of the Jesuits (St. Anne's) at Bandra, who claimed it as their property when Bombay was ceded. On their claim being disallowed the priests threatened to resort to arms, and even went to the length of assisting the Sidi Admiral in his invasion of Bombay. Consequently in 1719 the Monastery and the lands at Parel were confiscated, and with suitable alterations the "Parel House" was used from 1720 for over a hundred years as an occasional residence by the Governors of Bombay. In 1829 it became the Government House and the permanent official residence of the Governor.

In 1750 Grose described it as "a pleasant mansion house and what with additional buildings and improvements of the garden affords a spacious and commodious habitation". "Here the Governor may spend most part of the heats, the air being cooler and fresher than in town; and nothing wanting that may make a country retirement agreeable". Governor Hornby was the first to reside in the Parel House in 1776. In 1803 Sir James Mackintosh, the Recorder of Bombay lived there; he writers : "We inhabit by the Governor's kindness his official country house, a noble building with some magnificent apartments and with two delightful rooms for my library in which I am now writing, overlooking a large garden with fine parkish ground". The building was enlarged and embellished by Mountstuart Elphinstone (1819-27); it was he who built the right and left wings. Bishop Heber, in 1825, describes it as "very handsome having a fine staircase and two noble rooms one over the other of 75 or 80 feet long very handsomely furnished. The lower of these which is the Dining Room is said to have been an old and desecrated church belonging to a Jesuit College". The altar was in the room to the east of the Dining Room with an archway between. Recently (1913), while some structural alterations were being carried out in this part of the building the archway which had been evidently filled in, could be distinctly made out and a faint smell of incense could be detected coming from the old beams and the exposed brickwork. The house was repaired during the time of Viscount Falkland and a tombstone erected by Lady Falkland over her favourite dog "Cuba" in 1852 is still to be seen in the back garden. In 1859 "on the landing

place of the very handsome stone staircase stood a valuable marble bust of the Great Duke of Wellington". From 8th to 15th November 1875, H. R. H. the Prince of Wales (His late Majesty King Edward VII) occupied the end room in the first floor of the north wing of the building, but after the death of Lady Fergusson in 1883 from cholera the place was abandoned in favour of the house at Malabar Point. In 1897–98 the Old Government House was utilised as a Plague Hospital and in 1899 Mr. Haffkine's Plague Laboratory was transferred there ; and was until recently known as the Bombay Bacteriological Laboratory. It was only in 1926 that the Laboratory was renamed the "Haffkine Institute". Lately a scheme was under consideration for making extensive additions to the building, and equipping it as a School of Tropical Medicine.

Of the past glories of the Old Government House, a faint idea can be had from the main staircase and the decorated walls and ceiling of the old Ballroom. The garden at the back of the house which at one time was "very spacious and well looked after" has completely disappeared, and a prosaic cricket field occupies the place. The large tank at the back of the garden, "that beautiful sheet of water" which at Jonathan Duncan's grand ball to Arthur Wellesley and his staff, "became a fairy scene of gorgeous fireworks which blazed away far into the night and early morning over the faces of fair women and brave men". is now forgotten.

ARCHITECTURAL NOTES

St. Thomas Cathedral.– The Cathedral was commenced in 1715 and completed in 1718. The structure consisted of a central nave with side aisles and a semi-circular apse at the east end. The nave arcading is supported on massive circular pillars to carry the heavy masonry vault which forms the roof. The work is of no particular architectural interest although the Secretary to Government wrote on Christmas Eve two hundred years ago that it was "a structure deservedly admired for its strength and beauty, neatness and uniformity, but more especially for its echo". The present tower was added in 1838 and again in 1865 a new chancel and organ chamber were built in Gothic character and obviously begun with the intention of reconstructing the

entire Cathedral on the same lines. On the walls there are a number of interesting monuments and tablets.

The Mint.—The mint was originally completed about 1827 but has had many additions and alterations since. The west front of the main block is curiously pinched and narrow in appearance ; it has something of the renaissance in its character but little regard for proportion or composition.

St. Andrew's Church.—St. Andrew's Church of the Scotch Kirk stands near the old Apollo Gate to the fort. It was erected in 1818 and is a simple building on classical lines with a pleasing spire.

The Town Hall.—The building was commenced in 1821 and completed in 1833. It is a fine broad composition strongly influenced by the Greek revival. The building consists of a basement containing various offices with the hall proper over them. A very fine flight of steps gives access to the hall from the main road. The northern wing houses the library of the Royal Asiatic Society. There are some interesting pieces of sculpture in the Hall and staircase.

The Secretariat.—This building is a Gothic structure erected in 1864. It is very inconveniently planned for its purpose as an office building while the exterior is mean and suggestive of being patched together.

University Buildings.—The University Hall at the southern end of the University gardens was designed by Sir Gilbert Scott and completed in 1874. It is a spacious chamber with galleries, covered by a fine vaulted roof of Porebunder stone. The treatment is Gothic founded on early French work.

The Rajabai Tower and the University Library.—This group was also designed by Sir Gilbert Scott and is similar in character to the work of the University Hall. The Library is two storeys in height with Reading Room in the lower floor and the Library above, which is a fine room with a handsome timber ceiling. The Rajabai Tower rises in front of the Library to a height of 250 feet and throws the other buildings entirely out of scale. The Tower forms a prominent landmark from a distance, but the grouping is not happy when viewed in conjunction

with the adjacent buildings. This tower terminates in a somewhat unsatisfactory manner, great octagonal corner buttresses run up the entire height and finish in a feeble parapet from inside while, an octagonal lantern rises without connection or relation to the mass of the tower.

Telegraph Office.—The Telegraph Office now includes the building to the south which was originally put up in 1872 as General Post Office. This latter is a very charming composition externally, but is sadly lacking in all the essentials of a busy public office internally and the same may be said of the original Telegraph Office which is situated to the north of the old Post Office.

Sailors' Home, The Legislative Council Hall and Offices.—The Royal Alfred Sailors' Home, of which the foundation stone was laid by the Duke of Edinburgh, was opened by Lord Lytton then Viceroy of India in 1876. It occupies a very fine site and forms a quaint and interesting Gothic group somewhat marred by an evil practice of periodically whitening the Porebunder stone work of the central gable.

THE NEW COUNCIL HALL, BOMBAY

The Council Hall is situated to the rear of the Legislative Council Offices (the old Sailors' Home) and is connected with that building by a corridor. It provides for accommodating ultimately 148 members. It is surrounded by lobbies and anterooms on the ground floor. On the first floor galleries are provided for His Excellency the Governor, the President, distinguished visitors, and public and the press. A main stair-case is provided for His Excellency the Governor's gallery, the President's gallery and a distinguished visitors' gallery and a separate entrance and stair-case for the public. The designs of the building were prepared by the late Consulting Architect to Government Mr. J. Mercer, L. R. I. B. A. and the construction carried out by the Public Works Department under the Executive Engineer, Presidency, the works being done almost entirely by contract. The walls of the structure are of stone masonry with yellow basalt exterior facing. The roof is of reinforced concrete carried on steel girders, the two main girders above the Council Chamber being lattice girders 60 feet long and 5½ feet deep, weighing about 7 tons each. The flooring of

the Chamber and galleries consists of rubber asbestos and that of the corridors and lobbies of white marble. Teak-wood panelling has been provided to the walls of the Chamber to a height of 10 feet.

The building is the first in Bombay, and one of the first in India, to be equipped with a dehumidifying and air cooling plant. The plant, which has been supplied and erected by the Carrier Engineering Company, Ltd., consists of an ammonia compressor cooling apparatus, by means of which fresh air is cleaned, cooled and dehumidified to the correct temperature and degree of humidity. Thence the air passes through ducts and trunking to the roof, whence it is admitted into the Council Chamber through ventilators and passes downwards through the chamber thus maintaining the air at ths required temperature. It then passes out through ventilators in the floor of the chamber back to the cooling apparatus through the necessary ducts. The required temperature and humidity can be maintained constant as long as the plant is running, the regulation being automatic. The plant ventilates the hall itself together with the surrounding corridors and galleries.

The High Court.—The High Court was erected in 1879 and is a massive Gothic pile facing Mayo Road. In effect it is heavy and somewhat uninteresting and the internal arrangements are cramped and dark.

Public Works Secretariat.—This is another Gothic building with something of a Venetian flavour. It was begun in 1869 and completed in 1872 and a western wing towards Mayo Road was added later. The planning and internal office arrangements are bad, very little consideration having been given to the purpose it had to serve.

Victoria Terminus.—This group consists of a central station and administrative offices completed in 1888. It is designed in an ornate Gothic manner which appears to appeal to many.

Municipal Buildings.—The Municipal Buildings were opened in 1893. The structure occupies a traingular site, is Gothic in general treatment with Indian domes surmounting the Gothic towers. The group is dominated by a great central mass which is inclined to dwarf the remainder of the work. Inside there is a fine central stair-case and handsome Council Hall.

B. B. & C. I. Railway Offices.—This group of buildings is situated at the junction of Queen's Road with Marine Lines where it occupies a triangular site. It was designed by the late Mr. F. W. Stevens and completed in 1899. The style is a mixture of Gothic and Indian elements, but the general composition is very pleasing especially from a distance when the various features group with the central tower in a very satisfactory manner.

The General Post Office.—The New General Post Office was designed by Mr. J. Begg, and completed in 1911. The building consists of a partial basement, ground and three upper floors. The plan is arranged round a central hall which is carried up through the building and covered by a dome. All the public departments are reached from this central hall which ensures directness and convenience of working. The rooms throughout are airy and well lighted. The teatment of the building is founded on the Muhammadan work in Bijapur during the fifteenth and sixteenth centuries.

Prince of Wales Museum of Western India.—The foundation of this Museum is the outcome of His Majesty's visit to India as Prince of Wales in 1905. It was opened on the 10th January 1922 by Lady Lloyd. The building is two storeys in height. The work is of Indian character and was designed by Mr. G. Wittett.

The Royal Institute of Science—The Royal Institute of Science occupies a corner site at the junction of Mayo Road with Esplanade Road. It includes several units, the science college, a science library, a public hall and a block for chemical technology; the science college occupies the western and the southern wings with the library in the rear, the public hall is located at the angle of the site and technology department form the eastern wing facing Esplanade Road. These have recently been handed over to the University for the establishment of the School of Technology. The public hall is circular in plan with a diameter of 80 ft. The platform forms a chord of the circle. There are two galleries and the building is designed to seat over one thousand people. The group which is treated in a simple renaissance manner with well balanced masses was designed by Mr G. Wittett, F.R.I.B.A

Gateway of India.—This monument at Apollo Bunder, built to commemorate the landing in India of Their Imperial Majesties in December 1911, was declared open by H. E. the Viceroy, the Earl of Reading, on 4th December 1924. The land on which it stands was reclaimed specially from the harbour between the years 1915 and 1920. The building is founded on reinforced concrete piles 36 feet long, driven to rock, and is constructed of yellow basalt stone from the Kharodi quarries in the Thana District. The domes and galleries are of reinforced concrete, the central dome being 48 feet in diameter and 83 feet above pavement level at its highest point. The Gateway, which is ordinarily open to the public, is used for reception purposes on the occasions of ceremonial landings and departures and is calculated to accommodate 600 persons. The design is Indian in character based on the traditional architecture of Western India. The architect for the lay-out and the building was Mr. G. Wittet, F.R.I.B. A. The sea-walling and reclamation works were carried out by the Bombay Port Trust and the building itself was constructed by the Public Works Department.

STATUARY

Bombay possesses a number of fine statues scattered throughout the city, adorning either its public squares and gardens or the interior of its great buildings, museums and charitable institutions. The majority of these statues are from the studios of some of the most distinguished sculptors, while others are very indifferent productions.

The oldest statues are those located in the Elphinstone Circle Garden. The monument for the Marquis of Wellesley was originally received in Bombay about the year 1814 but was not actually erected until 1825. "The statue was suffered to be neglected for years after its arrival in the warehouse of Messrs. Forbes & Co., and it was with the greatest difficulty and only through the influence and liberal contributions of Sir Charles Forbes that money was raised to put it in its place". The Marquis, who is seated, holds a book in one hand and is presenting a bracelet to an athletic Maratha sepoy with the other. A female figure balances the group and a lion and lioness at the back form decorative accessories to the pedestal. In the same

garden stands also an attractive memorial to Marquis Cornwallis put up in 1824. The Marquis is represented standing upon a pedestal supported by two female figures, one representing Wisdom and the other Integrity. Both these groups were to have been modelled by Flaxman, but the work was for some unknown reason entrusted to Bacon. A third statue in honour of Pitt, which was also subscribed for along with these statues, does not appear to have ever been received in Bombay. These valuable statues which cost nearly £20,000 sterling need to be removed from their present out-of-the-way sites, and placed in more suitable and sheltered places, and protected against further ravages from exposure and rain.

The Town Hall which was biult " among other purposes for the reception of the statues of Marquis Cornwallis, Mr. Pitt and any future monuments of British Art which public gratitude may bring to Bombay ", contains a good collection of statues by celebrated sculptors. In the main hall is a fine statue by Chantrey of Mountstuart Elphinstone, Governor of Bombay from 1819 to 1827. In the South vestibule there is another specimen of Chantrey's work, *viz.*, a statue of Sir Charles Forbes, Bart., a " disinterested benefactor and the tried and trusted friend of the people of India ". The northern wing of the Town Hall, which is occupied by the Bombay Branch of the Royal Asiatic Society, contains a number of fine statues. Near the main stairs of the Library on the ground floor is a statue of Jagannath Shankarshet, by Noble, erected in 1864 by the inhabitants of Bombay as a " tribute to one of their most illustrious fellow-citizens ". At the top of the staircase is a statue of Sir John Malcolm, Governor of Bombay from 1827-1830; it is another piece of fine work by Chantrey. In the north-east corner is another statue by Chantrey, *viz.*, of Judge Babington, who revised the Judicial Code. Near by is a statue of Lord Elphinstone, Governor of Bombay (1853-1860), by Foley. On the opposite side is a statue of Sir Bartle Frere by Woolner, who has fairly well succeeded in making the most of an inartistic attire; in the corner close by is a statue by Theed of Charles Norris of the East India Company " whose labours in the judicial department were most useful to Government ". He is seated clad in a Roman toga. Next to him and sitting dressed in full

Parsi costume is a statue of the first Sir Jamsetji Jijibhoy by Marochetti; it was put up in 1858. In the Library's Meeting Room close by is a bust of Sir James Rivett Carnac, Governor of Bombay. This bust, which is not at all well finished, "was subscribed for in 1841, and arrived in Bombay in 1846, lay for three years in its packing case under one of the Town Hall stairs and was only discovered by accident". Murray (1859) states that the bust of Carnac was by Chantrey. The bust in the Meeting Room is by Macdowell, and if it had still remained in its packing case it would hardly have been much of a loss to Bombay. According to Murray there was also a bust of Sir James Mackintosh in the Library, but it is not there now. Bombay has neither a bust nor a portrait of this great scholar—"the most splendid character in the whole range of Bombay's history--made to love and to be loved with a transparent intellect that shed an electric light on everything it touched, and an imagination that soared far above the common level of mortals".

By far the largest majority of statues are to be found in the Fort district. St. Thomas' Cathedral contains some exceedingly handsome memorials. There is a fine monument by Bacon to Jonathan Duncan who for 16 years was Governor of Bombay; he abolished "infanticide in Benares and Kathyawad" and died in Bombay in 1811 in the old Governor's House in Apollo Street. Forbes' tribute to him is as follows; "thousands of happy mothers in all succeeding ages while caressing their infant daughters will bless the name of Duncan". Another fine memorial by Bacon is to Captain Hardinge who fell in a naval engagement off Ceylon. The other notable monuments are—to John Watson who was killed at the Siege of Thana, to Admiral Maitland to whom Napoleon surrendered on board the *Bellerophon*, and to Major Pottinger, the hero of Herat. Bishop Carr's effigy in full episcopal robes lies in the south transept, and Mrs. Kirkpatrick has also a very fine memorial by Bacon. The monument to Babington is by Chantrey in his best style.

A bronze statue by Wade of H. M. King George V in naval uniform stands in the garden of the Prince of Wales' Museum, and is a poor production. The panels on the pedestal represent

the laying of the foundation stone of the Museum and the reading of the address of welcome by the Municipal Corporation. In the open space to the north-west of the building is a fine equestrian statue of the late King Edward VII by Boehm. The granite base bears two panels, one showing the Indian Princes being presented to His Majesty by the Viceroy Lord Northbrook; the other, school girls of Bombay presenting the Prince with flowers. This statue was given to the city by Sir Albert Sassoon. In the Sassoon Mechanics' Institute close by there is a fine marble statue of David Sassoon by Woolner, and also a bust of James Berkley, the Engineer.

Sir Lawrence Jenkins' statue made by Talim is situated in the garden at the main entrance of the High Court. In the University Garden in front of the Cowsaji Jehangir Senate Hall there is another statue by Woolner, *viz.*, that of Sir Cowasji Jehangir, and to the east is Mossman's statue of Thomas Ormiston, who constructed the Prince's Dock and built the Lighthouse at Prongs. Both these statues appear to be lacking in graceful lines. The University Library building contains busts of Sir Bartle Frere by Woolner, of Gibbs by Belt, of Fawcett by Hope-Pinker and a bronze bust of Sir George Birdwood, holding an image of " Dattatraya ".

Looking towards the Gateway of India at Apollo Bunder there is a handsome bronze statue by Herbert Hampton of Lord Hardinge of Penshurst, Viceroy 1910-1916.

The Statue of H. R. H. the Prince of Wales in bronze by Leonard Jennings is erected to the east of the Band Stand near the Royal Institute of Science.

On the oval near the south-east corner stands a marble statue by Brock of the great educationist and social reformer, Sorabji Shapurji Bengalee and on the opposite side of the road is Mhatre's statue of Justice Ranade. At the north-east end of the Oval stands a statue of Sir Richard Temple, Governor of Bombay (1877-1880), by Brock. To the west of it is a fine bronze statue by Alfred Gilbert of Lord Reay seated dressed in the robes of the Chancellor of the University of Bombay, and further west is a statue of Lord Sandhurst, an inartistic piece of sculpture.

Just opposite, on the other side of Church Gate Street is the seated statue, in bronze, by Reccare of E. S. Montague, late Secretary of State for India, and a few yards to the east is Mhatre's statue in white marble of the great Indian statesman and patriot, Gopal Krishna Gokhale, who founded the Servants of India Society. At the junction of Mayo and Esplanade Roads is Noble's fine statue of Queen Victoria erected in 1872. Her Majesty, clad in royal robes, is seated under an exquisitely carved canopy of Gothic architecture; it was originally intended to be a companion statue to that of the Prince Consort in the Victoria and Albert Museum in the Victoria Gardens.

A few statues have been erected near the Municipal Offices. In front of the main entrance stands a fine bronze statue by Wood, of that famous citizen Sir Pherozeshah Mehta, who was for many years the most prominent member of the Bombay Municipal Corporation. On the border of the circular green to the south of the Victoria Terminus station and facing Hornby Road is a seated marble statue of the " great philanthropist and captain of industry, " Sir Dinshaw Maneckji Petit, the first Baronet, by Brock, and near the junction of Cruickshank and Waudby Roads is a memorial group in bronze by Colton to the " pioneer of Indian Industries " Mr. J. N. Tata. The "great partriot and phitanthropist " is represented as seated with two small allegorical figures in front.... " Industry ", as represented by a nude cooly straining at cotton bales, while a semidraped female figure represents "Science" * the winged figure overhead with a laurel wreath represents " Fame ". The general effect of the grouping is scarcely satisfactory. The heavy overhead figure, like the winged Victory of Samothrace with her drapery blown about by the wind, does not harmonize with the two little allegorical figures placed below. Further north is a marble statue of Dr. Blaney by Valla, an indifferent piece of sculpture; if this statue were mounted on a much higher pedestal the foreshortening effect would certainly go a great deal towards modifying its obvious defects.

The Council Hall of the Municipal Offices contains a number of busts. Roscoe Mullins is represented by busts of Sir Charles Ollivant, the Municipal Commissioner, and Sir Frank Souter, the

* The proper interpretation of this should be " Skill " (V. P. K).

Commissioner of Police. The other busts, *viz.*, of the late Queen Victoria, Dr. Blaney and Rao Saheb Mandlik are by the Bombay School of Art. There are also busts of Acworth, Harvey, and Captain Henry.

Erected in front of the Oriental Buildings is the statue in bronze and in sitting pose of Dadabhoy Nowroji made by B. V. Talim. This statue unfortunately suffers considerably in proportion with the large magnificent buildings in the surrounding.

Two marble busts are to be seen in the Royal Institute of Science —one by Mhatre of Sir Vassanji Tricumji in the library with which his name is associated and the other by Brock of Sir Cowasji Jehangir at the entrance to the Public Hall which was built from funds donated by him.

A marble statue of Sir Sydenham Clarke by Brock is inside the central entrance of the Royal Institute of Science.

A few pieces of sculpture are located in the Victoria and Albert Museum in the Victoria Gardens. In the main hall there is a very fine marble statue of the Prince Consort by Noble. The Prince is standing on a pedestal at the foot of which are two graceful figures representing Science and Art. This memorial contrasts very favourably with those marble statues and monuments which have been put up in various open places in Bombay and allowed to get damaged through exposure to the local climatic conditions so detrimental to these valuable treasures of Art. There are two more specimens of Noble's art here, *viz.*, the busts of Lord Canning and Mountstuart Elphinstone. The marble bust of David Sassoon is by Woolner, and in the entrance hall there is a plaster bust of Lady Frere. The original of the latter by Woolner was placed in a small Greco-Roman temple in the Victoria Gardens, but was unfortunately damaged beyond repair in a thunderstorm; the plaster replica has been presented by Lady Frere's son. A plaster replica of the bust of H. M. King Edward VII is to be seen at the top of the staircase.

In the J. J. Hospital there is a large bronze statue of the first Sir Jamsetjee in full Parsi constume, and in the adjoining Grant College library may be seen busts of Morehead, Ballingall, Peet and Haines, former Professors in the Medical College. Doyle Jones' bust of Dr. Cowasji Lalkaka is also placed here.

In this chapter we will also describe some of the Ornamental Fountains which are to be seen in Bombay. The Wellington Memorial Fountain lies to the south of the Prince of Wales' Museum and was erected in 1865 as a memorial to the Duke of Wellington, who as Sir Arthur Wellesley actually resided in Bombay in 1801 in a house, now demolished, at the foot of Malabar Hill, and again in 1804 in tents on the Esplanade. The Flora Fountain which stands at the junction of Esplanade Road and Churchgate Street was erected about the year 1866 in honour of Sir Bartle Frere, Governor of Bombay from 1862-1867. The fountain in the Cathedral compound is a gift of Sir Cowasji Jehangir, and an ornamental fountain is also located in the Elphinstone Circle. The fountain at the junction of Frere and Mint roads is a comparatively new structure and was built in 1894 by Mr. Ratansi Mulji in memory of his son whose statue it bears. A fountain with clock tower in the Assyrian style of architecture stands in Bazaar Gate Street, and was erected in 1880 in memory of Mr. Bomanji Wadia, whose statue by Westmacott in 1865 graces its interior. The Fitzgerald Memorial fountain and lamp, which stands at the junction of Cruickshank and Esplanade Roads was erected in 1867 to the memory of Sir Seymour Fitzgerald, Govornor of Bombay from 1867 to 1872. The Crawford Market contains a Fountain designed by Mr. Lockwood Kipling, father of Rudyard Kipling, who also sculptured the two decorative panels on the main entrance of the market buildings. Rudyard himself was born in Bombay in a bungalow on Chinchpokli Hill, now demolished. A fountain erected about the year 1864, now occupying a position at the foot of Byculla Bridge, stands in memory of Shet Cursetji Maneckji Cursetji, whose bronze statue crowns its Corinthian pillar. "He was in his time a great figure in Parsi life as the head of the old Punchayet and was much esteemed by Parsis, Hindus and Mussalmans for his many useful services". It was in his house at the foot of Malabar Hill that Sir Arthur Wellesley resided during his stay in Bombay before the Assaye campaign. The fountain in the centre of Jacob's circle has been erected to the memory of General Legrand Jacob.

The largest statue erected in the last decade is that of the great scholar and statesman, the late Mr. Bal Gangadhar Tilak

occupying a commanding position on the Chaupati sands. The Statue is in bronze standing on a very high pedestal and sculptured by R. K. Phadke and Kolhatkar.

PLACES AND OBJECTS OF INTEREST.

BOTANICAL AND ZOOLOGICAL.

Bai Sakarbai Dinshaw Petit Hospital for Animals.—This hospital is situated at Parel a little to the south of the Old Government House, and owes its origin to the Bombay Society for the Prevention of Cruelty to Animals. It was opened in 1884 and contains wards for Horses, Cattle and Dogs; all classes of animals are treated both as indoor and outdoor patients.

Attached to the Hospital is the *Government Veterinary College,* which trains students as veterinary practitioners. It has a large Museum, Library, Pharmacy, Shoeing Shed and Chemical and Pathological laboratories.

Pinjrapole.—This is an asylum for decrepit animals, and is situated in the heart of the city at Bhuleshwar. The institution was founded in 1834 by the Hindu and Parsi Communities of Bombay and contains a large number of horses, ponies, cattle dogs, goats, buffaloes and other animals; medical treatment is provided for diseased animals.

Natural History Society. (See Museums.)

Victoria Gardens.–These gardens are situated on Parel Road near the Byculla Railway Station, they were originally laid out by the late Sir George Birdwood in 1861 on what was then a " useless and low-lying " piece of land and stocked with plants from the Agri-Horticultural Society's Garden at Sewri, the latter being converted into a Christian cemetery. Since 1873 the Victoria Gardens have belonged to the Bombay Municipality.

The entrance is near the David Sassoon Clock Tower which has a fountain. Close to the entrance is the *Victoria and Albert Museum* (see Museums). To the east of the building is a massive-stone elephant, lately restored; it originally stood on the southern shore of the island of Elephanta. Beyond it is the triple-arched gateway the entrance to the gardens

proper. The gardens are well laid out with broad paths, raised terraces, ornamental ferneries, and miniature lakes, and contain many choice and rare species of tropical trees and plants. (See article on "Some Interesting Economic Plants in the Victoria Gardens".) The Zoological collection comprises many kinds of living mammals, birds and reptiles. Among the collection there are wild donkeys and some rare animals such as the Panda or Catbear (*Ælurus fulgens*) from Nepal, and an Albino variety of the Rib-faced or Barking deer (*Cervulus muntjac*). A former Superintendent of this garden was successful in breeding some Rheas, and also a Zebra. This is believed to be the first instance of Zebras breeding in India.

CEMETERIES.

Christian.—The first English cemetery in Bombay was on or near the site of the present Sailors' Home, and was known as *Mendham's Point*, possibly named after the first man buried there. In 1760, however, strategic reasons forced Government to demolish it along with other structures opposite the old Apollo Gate. A new site for burial was then selected on the Chowpatty foreshore near the Hindu Burning Ghat and the old Portuguese Cemetery at Sonapur; and it was in use from 1763 until 1867, when the present cemetery was opened at Sewri. Christian burial grounds also existed at Matunga, Marine Lines and at Colaba Point, but these also have been closed for burial.

The Sewri Cemetery was originally a botanical garden of the old Horti-Agricultural Society, but was purchased and laid out as a cemetery for Protestants, Roman Catholics and Presbyterians, consecrated and opened in 1867.

The Hindu Burning Ghat at Sonapur, on Queen's Road, has been in use as such from the year 1677 when Aungier gave permission to the Banias from Diu to burn their dead on the Back Bay Sands. The place was probably walled in when Queen's Road was constructed. Cremation is carried out in a crude manner. No proper crematoria for the disposal of the Hindu bodies exist in Bombay. A small crematorium which was erected in the compound of the Acworth Leper Asylum at Matunga sometime ago and which was worked with success, has now fallen into disrepair.

Muhammadan burial places also exist along Queen's Road.

Parsi Tower of Silence. The Parsi mode of disposing of the dead is over three thousand years old and the places specially built for the purpose are known as the Towers of Silence. They are all situated in an extensive piece of ground on the highest part of Malabar Hill to the west of Gibb's Road. The grounds contain five towers. Of these the oldest, known as the Modi Tower, was built by Modi Hirji Wachha, one of the earliest Parsi settlers, about the year 1673; the second oldest tower was built by Maneckji Seth about 1751. These two towers bear no inscription. The third known as the Anjuman's Tower was built in 1779 and bears an inscription in Persian. The remaining two, known as Framji Banaji's Tower and Cowasji Bisni's Tower, were consecrated in 1832 end 1844, respectively and bear inscriptions in Gujarati. Each tower is a round massive stone structure with a raised wall. A few steps from the ground lead to an iron gate which opens on a circular platform having three graduated rows of shallow receptacles for receiving the bodies, the outermost for men, the middle for women, and the innermost for children. In the centre there is a large well. The vultures do their work expeditiously and within a very short time only the bones are left, which when perfectly bleached by the powerful action of the tropical sun, are thrown into the well where they gradually crumble into dust. Four underground drains carry off the rain water from this well through filters of charcoal and sand-stone into subterranean wells provided with a thick layer of sand at the bottom, so that all water passing over the bones is thoroughly filtered before it enters the ground. Smoking is strictly prohibited within the premises and cameras should not be taken inside. The necessary passes for admission are issued by the Secretary of the Parsi Punchayet.

CLUBS AND GYMKHANAS.

The Byculla Club is situated in the Byculla district on Bellasis Road. It is the oldest club in Bombay, and was founded in 1833 when it was established in its present quarters, part of which originally formed the "Byculla Assembly Room" and was used as a grand stand for the Byculla races. The crest of the club represents the Byculla Turf pavilion as it existed in

the year 1814. The club garden contains several rare plants and trees.

The Bombay Club is situated on Esplanade Road, and has arisen out of the old Indian Navy Club whose relics in the shape of a Burmese bell and several candelabra it still possesses.

The Royal Bombay Yacht Club.—Boat racing was in vogue in Bombay as early as 1839, but there was no club house until 1881. The present building which is situated on the Apollo Bunder reclamation was opened when Captain (afterwards Sir Henry) Morland was the Commodore of the Club. The Club and its yachts have the permission to fly the Blue ensign of the Fleet. The residential quarters in connection with the club are situated on the opposite side of the Apollo Bunder Road.

The Orient Club was opened in 1900 for encouraging intimate relations between European and Indian gentlemen. It is located at Chowpatty in a building of its own, opened in 1910.

The Willingdon Sports Club.—This club, which is located near Hornby Vellard, lies to the south of Clerk Road upon a large piece of low-lying ground reclaimed by filling it up with road sweepings of Bombay. The extensive club grounds with an area of 35 arces are laid out for all kinds of outdoor sports and games; the pavilion which stands upon a large terrace commands a good view of the play-fields and a fine polo ground. The club was opened in 1917 and has both Europeans and Indians as members, and is conveniently situated near the Race Course; but breezes from Love Grove, and the dust laden atmosphere of the surrounding flats go a great deal—towards spoiling the attractiveness of this club.

The Bombay Presidency Radio Club—was founded with the main object of providing an institution to stimulate interest in and foster the study of radio communication and allied arts. The club is situated in a spacious building opposite the Churchgate Railway Station.

Gymkhanas.—The Bombay Gymkhana for European residents is situated at the junction of Esplanade and Waudby Roads. The Parsi, Hindu, Islam, Catholic and German Gymkhanas are all located along Queen's Road between it and the Back Bay.

The Commercial and Japanese Gymkhanas are near the Cooperage. The Ladies' Gymkhana is on Malabar Hill and the Princess Victoria Mary Ladies' Gymkhana which has both European and Indian ladies among its members is also near the Cooperage.

EDUCATIONAL INSTITUTIONS.

THE UNIVERSITY OF BOMBAY

From the year 1857 in which it was first established till the year 1904 the University of Bombay was functioning in a comparatively limited sphere. Its activities were mainly directed to the examination of candidates and the prescribing of courses of study for the examinations leading up to its degrees. The Act of 1904 inaugurated a new policy with regard to University education throughout India by converting the Indian Universities from merely examining bodies into teaching institutions which would provide instruction, and promote study and research by means of lectures, libraries and laboratories. The defects of the Act, which were inherent in a piece of legislation which was intended to serve the educational needs of the different provinces which had so little in common with one another, soon became patent, and each Province had sooner or later to make a demand for separate legislation. The idea of University education was also undergoing an important change. New Universities of the residential and unitary type, as opposed to the older Universities of the affiliating type, were springing up in various parts of the country. The latter Universities had to keep pace with the new and progressive ideas, while still unable to shake off the burden of affiliated institutions which was their heritage. The most they could do was therefore to concentrate their energies on postgraduate teaching and research, and give an impetus to these activities by employing their own agencies for teaching and research in the higher branches of learning. Thus, the University of Bombay was reconstituted by the Act of 1928.

The change in the constitution of the University of Bombay was of a twofold character. Not only was a new direction given to its activities, but the University bodies were made more representative and democratic. The Senate which till then had consisted mainly of nominated members was thrown

open to the elected representatives of a large variety of interests. While under the Act of 1904 there were only two constituencies which elected their representatives to the Senate, namely, the Registered Graduates and the Faculties, several new constituencies were brought into existence by the new Act. The Principals of Colleges, University Teachers, Headmasters, Municipalities and Local Boards, the Legislative Council and certain important Commercial Associations were for the first time given representation. The proportion of the nominated to the elected element was considerably reduced. A new and important body to look after the purely academic part of the University's work consisting of academic men and experts in the different branches of study was created. Another body to control, and co-ordinate postgraduate teaching and research was also constituted, and an attempt was made, though not a successful one, to define and demarcate the powers and functions of the governing body, the executive body, the purely academic body and the special body created to control only postgraduate work.

The Act was evidently not a very workmanlike piece of legislation, as it contains many overlapping, and some inconsistent provisions. In some portions the wording is defective and lends itself to different interpretations which are often conflicting. The constitution of the various University authorities renders frequent elections necessary. These and many other shortcomings are apparent to those who take part in the work of the University. Attempts are being made to remedy them by corrective legislation both outside and within the four corners of the Act. It is however gratifying to find that, in spite of all these handicaps, the University has made considerable headway during the five years of its new life. A large output of research work in Science, Economics, Sociology and History, to mention only the most important branches of learning, has been a feature of this period. One very far-reaching decision was taken by the University last year by instituting a new Department of Chemical Technology, which will eventually develop into a full-fledged College of Technology. The University of Bombay has thus been one of the first in India to provide higher education with a vocational bias, which is suited to the needs and conditions of the Presidency. The new Department will specia-

lize in textile chemistry, and chemical engineering, and the courses of study in these subjects will be opened from June 1934. It is hoped that this new activity of the University will bring it more and more into touch with the industrial life of the city to the mutual advanage of the University and the cotton industry, which is the staple industry of the city and the Presidency.

Elphinstone College.—This is the principal Government Arts College in the Presidency and has been located in its present building in the Fort since 1888 after several changes of situation. It was originally the outcome of a meeting of the citizens of Bombay held in 1828 to decide upon a suitable memorial to the Hon'ble Mountstuart Elphinstone, Governor of Bombay from 1819 to 1827, and esteemed as "father and friend." The following resolution was passed at the meeting: "that the most satisfactory and durable plan of carrying their public wishes into effect is by accumulating a fund of money to be vested in Government securities, from the interest of which, according to its amount, one or more Professorships (to be held by gentlemen from Great Britain until the happy period arrives when the natives shall be fully competent to hold them) be established under the Bombay Native Education Society, for teaching the English language and the arts and sciences of Europe: and that these professorships in compliment to the person in reference to whom the meeting has been convened, be called the Elphinstone Professorships." In 1835 the "Elphinstone Institution" was constituted and in 1836 Professors were brought from Europe for teaching purposes. In 1855 the late Mr. Dadabhoy Navroji was appointed the first Indian Professor of Mathematics, and in 1856 the institution was divided into a College for the higher studies, and a School for the lower standards. The college was recognised by the University of Bombay in 1860. There is a hostel for students in connection with the College.

Royal Institute of Science.—Next to the Elphinstone College, is the large building which contains this Institute with its physics, chemistry, botany and zoology laboratories. It also possesses a good scientific library. The Institute began work in 1920 (see separate note).

Wilson College—This College is to be traced to an English School for Indian youths founded by the Rev. John Wilson in

1832, and originally dependent on local contributions. It was recognised by the Church of Scotland in 1835, and in 1843 its supporters completed the erection of the building in Kalkadevi known until recently as the General Assembly's Institution. But at this time Dr. Wilson and his colleagues retired and work passed under the control of the Free Church of Scotland. Consequently another building had to be procured. The School which was then designated the Free General Assembly's Institution was henceforth located in Khetwadi In 1861 the higher section was affiliated with the University and the Institution was recognised as teaching the entire Arts course. Later it was recognised for the Science courses when these were instituted.

In 1882 the Rev. Dr. Mackichan being on furlough was authorised to raise subscriptions towards the erection of a new building for the College department which would be separately known as Wilson College. About £6,000 were subscribed in Scotland. Several Native Princes of Western India, from respect for the memory of Dr. Wilson, gave substantial contributions. A site in Chaupati was liberally granted by Government. The building, including external Laboratory was erected at a cost of Rs. 1,81,000 of which Rs. 87,000 were granted by Government. The foundation stone had been laid by His Excellency Sir James Fergusson on 10th March 1885, and the new College was formally opened by His Excellency Lord Reay on 14th March 1889. Classes commenced in the new building in June of that year. In 1908 by means of an Imperial Grant of Rs. 50,000, a third storey was added to the main building; and about the same time the Chemical Laboratory was enlarged.

In 1925 the main building was extended at a cost of about 2 lakhs of rupees, and towards the cost of this extension Government made a generous grant of over one lakh of rupees. The extension was formally opened on the 17th February 1925 by His Excellency Sir Leslie Wilson.

The College possesses three hostels—one in the College grounds which grew out of the hostel which was erected at the same time as the main College building and has accommodation for about 80 students, a second named "Mackichan Hall" with rooms for 120 students erected in 1912-13 at a cost of over

Rs. 2,00,000, on a site immediately adjoining the College grounds; and the third the Pandita Ramabai Hostel for women students, erected in 1932 mainly from funds given by the American Ramabai Association.

In 1900 the Free Church of Scotland entered into union with the United Presbyterian Church of Scotland, and from that year till 1929 the College belonged to the United Free Church of Scotland. In 1929 with the re-union of the Scottish Churches the College came again under the Church of Scotland. It is supported by funds annually contributed by the Church of Scotland, by fees and Government grant.

JOHN McKENZIE.

St. Xavier's College.—The College is under the management of the Spanish Fathers of the Society of Jesus. It owes its origin to the development of St. Mary's Institution (1864) and St. Xavier's High School and was affiliated to the Bombay University in 1869. It was founded with the object of providing the Catholic youth of the Presidency with a full course of liberal education. Non-Christians are likewise admitted. Under the management of the same Society are the St. Mary's High School Bombay; St. Xavier's High School, Bombay; St. Stanislaus' High School, Bandra; St. Patrick's High School, Karachi, and St. Vincent's High School, Poona.

There are 12 Fathers, 35 Lay Professors and 21 Fellows in the Staff. Besides a Treasurer, 8 Clerks, a Curator, a Foreman, a Storekeeper, a Mechanic, a Driver and 31 menials.

The total number of students is 1551 and 177 postgraduate students. There are 320 Christians, 391 Marathi speaking Hindus, 275 Gujarati speaking Hindus, including Jains; 448 Parsis, 76 Mahomedans, and 41 Jews. Out of these 281 are Women.

The Subjects taught are:—

I. Languages: English, French, Hebrew, Sanskrit, Latin, Arabic, Pali, Portuguese, Urdu, Persian, Marathi, and German. II. History and Political Economy. III. Philosophy. IV. Mathematics. V. Physics. VI. Chemistry and Geology. VII. General Biology, Botany, Zoology, and Microbiology. VIII.

Intermediate Science for Medical and Engineering Students. IX Religion for Catholics. X. Ethics and Moral Philosophy.

The College possesses a fine Library mainly of English, French, German and Spanish books. Noteworthy are the sections in the Library, of History, Sanskrit, Biology and Physics.

The Biology Department includes a Microbiology Laboratory and one of the finest Herbaria in India. The Chemistry and Physics Departments are capacious and well equipped. The Geology Department was for a long time unique.

Research is being done in History, Mathematics, Physics, Chemistry, Biology and Geology. Attached to the College, is the Indian Historical Research Institute. From work done there, several volumes have been published.

The Hostel gives accommodation to 100 students of different communities.

The College Magazine and Gymkhana, as well as the Academic results, are acknowledged to rank among the best.

G. PALACIOS.

The Sydenham College of Commerce and Economics— The general purpose of this college is to furnish young men embarking on a business career with a university eduction of such a kind as will assist them by deepening and widening their understanding of industrial and commercial organisation, to rise to the more important and responsible positions in their respective vocations and concurrently from the larger public and cultural point of view to promote the study of social conditions in general by means of specialised courses in the various branches of Economic Science and by original research.

The College which is a Government Institution was opened in October 1913. It is affiliated to the University of Bombay and alone of all institutions in India provides a systematic course of study leading upto the degree of Master of Commerce. There are about 12 Government special scholarships sanctioned for 'Intermediate' and 'Backward' Hindus and Muhammedans. There are as well University, College and State scholarships in addition to prizes and a gold medal. It has got its own hostel

in a rented building. Apart from the degree course, classes for preparing students for Government Diploma in Accountancy and for the 'First' Examination under the Auditor's Certificates Rules are held in the College generally in the evening. Shorthand classes are also held. Short courses of evening lectures on some important commercial and economic problems are delivered free of charge for the benefit of those engaged in business during the day and desirous of studying in their spare time some particular subject in which they happen to be interested. The first principal was Mr. P. Anstey and Mr. M. L. Tannan, who is the permanent Principal of the College, is at present on deputation to the Government of India as Under Secretary, Department of Commerce, and Secretary, Indian Accountany Board.

M. J. ANTIA

Government Law College.—This was founded in honour of Sir Thomas Eskine Perry, Chief Justice of Bombay, on the eve of his departure in 1852. It was recognised by the University in 1860. The College possesses an excellent Library.

Secondary Training College, Bombay:—The Secondary Training College aims at providing secondary schools with a supply of trained teachers and undertakes investigations into educational problems. It was founded in 1906, and for the first 14 years of its existence prepared teachers for its own Diploma, which was known as the Secondary Training College Diploma (S. T. C. D.). In 1920 the College was affiliated to the University of Bombay for the purposes of the degree of Bachelor of Teaching. The curriculum of the College is now based on the requirements of the University for that degree and the award of the Diploma has been discontinued.

The College is located in Cruickshank Road, in the Elphinstone High School Buildings; this school is used as its Practising School.

Admissions:—All graduates (in any Faculty) of the University of Bombay or of a University recognised by the University of Bombay are eligible for admission. The College admits 100 students each year and a few places are reserved for

Government teachers; the remaining places are open to graduates of either sex who wish to qualify for the B. T. degree. Preference is given to teachers deputed from recognised schools in the Bombay Presidency.

Fees and Scholarships:—No Fees are charged for tuition. Stipends of Rs. 30 – per mensem, not exceeding 25 in number, are awarded annually by the Director of Public Instruction to selected teachers from non-Government schools and to graduate students who are not attached to any particular school. Teachers deputed from Government Schools by the Director of Public Instruction receive their ordinary pay plus any allowances sanctioned for them.

Hostel:—The Hostel, which is situated near the College, accommodates 25 students. All full-time students are eligible for rooms, but preference is given to Government teachers. One of the senior members of the College staff is resident Superintendent and the Principal resides in the same compound.

Staff and Curriculum:—The staff consists of a Principal and seven others – Professors and Lecturers — each of whom is a specialist in the art of teaching his own subject. The curriculum is framed to suit the requirements of the B. T degree, but the College lectures and demonstrations aim at giving the student a broad view of his subject without seeking to expound any particular textbooks. The syllabus includes the following subjects:–

The Principles of Education; the History of Education (European and Indian) and the Practice of Education (School Management and Hygiene, Modern Movements in Education and Special Methods).

H. V. HAMPTON.

Ismail College, Andheri:—This Government College owes its existence to the munificent donation in 1914 of Rs. 8 lakhs by Sir Mohamud Yusuf Ismail, Kt. for the promotion of higher education of Mahomedans. After considering various alternatives, Government decided to devote the donation to the establishment of a first grade Arts College, a part of the funds, viz. Rs. 3,25,000 being set apart as an endowment fund for scholarships. In March 1924, Sir

Leslie Wilson, the Governor of Bombay, laid the foundation stone of the College, which commenced work in June 1930 when the buildings were completed. A tablet to commemorate the opening of the College was unveiled by His Excellency Sir Frederick Sykes, Governor of Bombay who speaking on that occasion emphasised " the fact that the Ismail College is not intended, in any sense, to be a ' segregate ' institution. Its main object is to provide an all round University education for Mahomedans, laying stress on those branches of learning which are predominantly Mahomedan, and which have been, perhaps, unduly neglected in this Presidency–the study of classical Arabic and Persian, and of Islamic Culture and History. But the doors of the Ismail College will be open to admit non–Muslims irrespective of caste or creed, and in this way the College will serve a very valuable secondary object, namely, the provision of educational facilities for suburban residents and the relief of the congestion in the urban colleges. The ever increasing tendency to move out into the suburbs has been one of the most marked features in the development of Bombay during the past decade, and it is obiviously inadvisable to compel students to come into the city again for their education. The Bombay colleges, with their overcrowded class-rooms noisy surroundings, and lack of adequate facilities for recreation, have long been a perplexing problem for the University authorities, for which I trust the Government of Bombay has now to some extent provided a solution ". The College occupies a beautiful site on a hill in Jogeshwari (Bombay Suburbs) about 15 miles from the Fort and commands a large view of the green hills around and the blue seas on the west. The main building houses the lecture rooms, laboratories, library etc. Lower down on the hill are the Hostel, the Pavilion and the reading room facing the wide expanse of the fine play-ground. In view of the increasing demand for Hostel accommodation a new block is being added to the existing one. Within its short existence of three years, the College has developed a unique atmosphere for work and play. It has numerous undergraduate Clubs and Societies, the chief amongst them being the Debating. Gymkhana and Hostel Unions and the Historical, the Economics, and the Philosophical societies. The post-graduate work is carried out by the College professors in

English, Persian, Arabic, Pali, History, Economics, Philosophy and Mathematics.

University School of Economics and Sociology.—The establishment of the departments of Economics and of Sociology is very significant in the history of postgraduate education and research in the province, as it represents the first organised attempt of the Bombay University at imparting postgraduate instruction and training in research through its own professors, in its own institution conducted solely for postgraduate instruction and research. The department of Sociology was unique in India as the only full-fledged department of the University devoted to the study of Sociology when it was started in 1919 with Sir Patrick Geddes as the professor in charge. The department of Economics was started in 1921 with Mr. K. T. Shah as the Professor in charge. Both these departments are now housed in a magnificent building which forms the south wing of the University block of buildings. The University spends on them more than Rs. 53,000 annually out of which Rs. 5,000 are spent on books and periodicals and Rs. 7,200 on studentships to research students.

Since the Congress met last time in Bombay in 1926 the school has made much progress both in the output of research work and in the number of students enrolled. There are at present in both the departments together more than 100 students of whom about 30 are engaged in research. The Library of the school now possesses about 18,000 volumes including Government publications and periodicals. Nearly sixty theses have been successfully completed.

The following list gives names of only those works which may interest the members of the Congress:—

(1) Religion and Society; (2) Indian Christian Community; (3) Hindu Exogamy; (4) Life and manners of XVIII century Maharashrta; (5) Chitpavan Brahmans: a social and ethnic study; (6) Social History of Gujarat during XIX century; (7) The Vadnagar Nagars of Gujarat; (8) Marriage and Family in Gujarat; (9) The Katkaris, a study in Primitive Social Life; (10) Genealogical study of some Vital Problems of Population; (11) Changing ideas of marriage and family;

(12) The Amil Community of Sind Hyderabad; (13) Dasha-shrimali Jains of Kathiawar; (14) Hindu Art in its social setting; (15) Chodhras of Gujarat; (16) Untouchability in Maharashtra; (17) The Protestant Indian Christian Community; (18) Untouchables in Kathiawar; (19) Fushkarnas; (20) Castes of Gujarat, Hindu Kinship; (21) The Role of Custom in the Development of Hindu Law; (22) Works of Untouchable Class in the city of Bombay; (23) Some Indian Christian Communities in Salsette; (24) The Warlis and (25) The Bene-Israel.

Of these the first fifteen completed works are available for inspection in the Library of the school and the rest are in progress.

G. S. GHURYE.

Royal Institute of Science.—Realising the importance and value of science Lord Sydenham, F. R. S., in 1907 during the first year of his Governorship of the Presidency appealed for help in providing for facilities for the study of science in the University of Bombay. This appeal met with generous response and the foundation of the Royal Institute of Science was made possible by a number of munificent donations, Rs. 2,860,000 being provided.

The building is regarded as one of the finest pieces of architecture in a city of architectural triumphs. It is a magnificent two storeyed stone structure, some 50 ft. high, with a total frontage of nearly 400 yards on the Mayo and Esplanade Roads. The two wings into which it is divided are joined by the Sir Cowasji Jehangir Public Hall, a circular hall 100 ft. in diameter and 65 ft. high with a seating accommodation for 1,200 people. The east wing over 150 ft. long on the Esplanade Road, has recently been made over to the Bombay University for housing the newly established School of Technology. The interior of the building is severely plain for the most part, but, the interior of the Library, the dome above the main staircase and the life-size statue of Lord Sydenham in the entrance hall are each a thing of beauty.

The foundation stone of the building was laid by Lord Sydenham on the 5th of April 1911, but owing to War the

actual starting of the Institute was delayed until 1920. In that year Dr. C. J. J. Fox was appointed as first Principal together with other members of the teaching staff who now number twenty-one. After his retirement he was succeeded by Dr. A. N. Meldrum, who in turn gave place to Dr. T. S. Wheeler, the present Principal.

The Royal Institute of Science is used both for teaching and research, emphasis being laid on the latter. Undergraduate classes are conducted for Intermediate and B. Sc. Examinations of the University of Bombay. Research is being carried out by members of the staff, by postgraduate students studying for M. Sc. and D. Sc. of the University and by others who desire facilities. There are about 200 undergraduate and 100 post-graduate students.

The Library building which is attached to the main building contains about 4,000 books and takes 90 periodicals. This collection of scientific books and periodicals is considered to be the best in the Bombay Presidency.

The Central Stores and Workshops are situated in the basement, which also contains a distilled water plant, a liquid air machine, glass blowing room and main switch board. The battery which is housed in a building in the compound adjoining the Stores has a total capacity of 250 ampere-hours.

Each of the departments, Physics, Mathematics, Chemistry, Botany and Zoology is administered by the Professor of the subject; the department of Chemistry is in charge of the Professor of Physical and Inorganic Chemistry, the Principal being the Professor of Organic Chemistry.

The Physics Department occupies the whole of the ground floor and a part of the west section of the second floor and is interested in developing the technique of teaching experimental physics, in studying properties of liquid amalgams, the electronic band spectra, the spectral intensity measurements, the Raman effect, the fine structure of spectral lines, the deflection of the elastic plates and the conditions underlying the formation of cloud systems. Dr. S. K. Banerji, a meteorologist in the Poona Meteorological Office, formerly at Colaba Observatory is also Honorary Professor of Applied Physics at the Institute and delivers lectures

to post-graduate students and carries on research work in atmospheric electricity and hydrodynamical problems.

The Department of Chemistry is engaged in conducting a systematic research on the crystal structure of azo-compounds. Investigations are also being carried out on gels, photolysis, the chemistry of oxides of cobalt and related metals and on the study of aqueous solutions of the sodium salts of weak acids. On the organic side, work is being done on Physico-Organic problems, on the chemistry of imido-chlorides of salicylic acid. derivatives of certain types of sulphur compounds, flavones and on various condensation reactions.

Dr. M. S. Patel, Chemist to the Department of Industries and Honorary Professor of Chemistry at the Institute, has made a beginning towards Industrial Chemical research. Work is being done on hydrogenation of Indian Oils, on production of paper from rice straw and allied problems.

The Department of Mathematics works in conjunction with the Physics Department on the deflection of plates and the theory cf regular skew polygons.

The Department of Zoology is studying the local marine fauna and problems connected with marine biology.

The Department of Botany specialises in Plant Physiology and is responsible for publishing a number of papers dealing with photosynthesis, chlorophyll and allied substances. The head of the department on account of his work on Rice Physiology. has won recognition from the Imperial Council of Agricultural Research, who have given him a grant of Rs. 10,000 for the purpose.

Since the initiation of research in this Institute in 1922, there has been a steady growth in the number of papers published and the number is now approaching 100. The Institute has also done a great deal to raise the standard of undergraduate science teaching in the Presidency.

There is also a comfortable Hostel for about 25 research students opposite the Institute buildings.

The work is now hindered by the present financial stringency. But when this passes off and the coffers of Government and of the public are once more opened to aid the cause of scientific progress, the Institute can look forward to achievements in the future even greater than those of the past.

T. S. WHEELER.

Victoria Jubilee Technical Institute:—The Victoria Jubilee Technical Institute was founded in 1887, largely through the princely munificence of the then Sir Dinshaw Maneckji Petit, Baronet. On its foundation, it was located in the old Elphinstone College buildings in Byculla and was started with two departments which were staffed and equipped to deal with the teaching of Mechanical Engineering and Textile Manufacture, the two technical subjects of greatest importance to Bombay and its industries in those days. With the advance of Electrical Engineering and the increasing use of electricity in industry in the early years of the present century, an Electrical Engineering Department was established and later Departments of Technical and Applied Chemistry and Sanitary Engineering and Plumbing were organised and started.

Owing to the expansion of the work of the Institute and the increasing numbers of students, it was found necessary about fifteen years ago to provide more and better accommodation; so land covering about sixteen acres was acquired from the Bombay Improvement Trust in Matunga, and new buildings were erected thereon. The erection of these buildings, which consist of a main building containing administrative offices, library, drawing offices and lecture rooms, workshop and laboratory blocks, power station and students' hostels, was completed in 1923, when the whole of the Institute was transferred to them. They have recently been extended by the addition of a new building which is reserved exclusively for the Department of Textile Manufacture. This building, when fully equipped will be a model textile mill, and at the present time contains some of the latest types of textile manufacturing ma[illegible]ery.

The Institute emphasises the practical side of technical training, and all students spend a good part of each week of the session in the workshops, textile mill and laboratories.

In addition to the above-mentioned branches of technology, which are attended by whole-time students during a four-year course, the Institute conducts classes for apprentices and others in engineering and textile mills and for electrical wiremen on Saturday mornings. These classes are attended by large numbers of young men, and are supplying a real need as they cater for those who, during the week, are engaged in earning their living and have only a limited amount of time at their disposal for securing a theoretical technical training.

Geo. W. BURLEY.

Grant Medical College.—This is one of the two Institutions in the Bombay Presidency for teaching medicine which are recognised by the University of Bombay. It is situated in the grounds of the Jamsetji Jijibhoy Hospital on Parel Road and was founded in 1845 in memory of Sir Robert Grant, Governor of Bombay. The building was designed by Capt. W. B. Goodfellow, R. E., and is in keeping with the style of architecture of J. J. Hospital which adjoins it. It is provided with probably the highest porch in Bombay adorned with the Coat-of-Arms of Governor Grant and the East India Company. With the exception of certain endowments for the encouragement of deserving students the College is entirely supported by Government. It was recognised by the University in 1860 and is well equipped with Laboratories for practical work in all branches of medical science.

The College has a large building for the Anatomy department with dissecting rooms, as well as Laboratories for practical work in Physiology, Hygiene, Pathology, Bacteriology, all equipped in a thoroughly up-to-date manner.

Attached to the College is a large hostel.

Adjoining the Grant Medical College is the Framji Dinshaw Petit Laboratory for Scientific Medical Research.

King Edward VII Memorial Hospital

and

Seth Gordhandas Sunderdas Medical College, Bombay.

History of the Hospital and the College.—By the passing of the Bombay Police Charges Act 1907 it became imperative on the Municipal Corporation of the City of Bombay to extend the work of Medical Relief in the City. The want of a fully equipped large general hospital was keenly felt to meet the growing demands of the rapidly developing portions of the north of the Island. In the year 1909 the Municipal Commissioner was asked by the Committee appointed by the Corporation for the purpose of extending Medical Relief to put before them definite proposals for the establishment of a fully equipped modern hospital in a suitable locality. Soon after this, on the death of His Imperial Majesty, King Edward VII, the people of Bombay decided to raise in this City a suitable memorial to his reign. In September 1911 the Secretaries of the Memorial Fund Committee informed the Corporation that their Committee has decided that "a hospital in the Northern part of the Island would form a most fitting memorial to His late Majesty." They also reported that they had collected funds to the extent of about six lakhs of rupees and that the Government had granted a free site measuring 50,000 square yards on the Parel Government House Estate, the market value of which was then estimated at five lakhs of rupees. The Corporation welcomed this offer of assistance and replied that as they had intended to build a hospital themselves they would be prepared to build, equip and maintain the hospital. Towards the cost of its construction the Government subsequently contributed a sum of four lakhs of rupees. The foundation stone of the Hospital was laid on the 25th December 1920 and the building was completed in the year 1925.

In the year 1916 another development took place in the history of the Hospital. At the instance of the Trustees of Seth Gordhandas Sunderdas, the then Advocate General, the Hon. Mr. D. N. Bahadurji offered to the Corporation a donation of Government Loan Notes of the face value of Rs. 12 lakhs (which

was subsequently increased to Rs. 14,50,000 in $3\frac{1}{2}$ per cent. Government Promissory Notes) for endowing a medical college in connection with the King Edward VII Memorial Hospital. The endowment was made on the following conditions:-

(*a*) That the College should be established in connection with and be attached to the King Edward VII Memorial Hospital.

(*b*) That the College should be affiliated to the University of Bombay and proper provision should be made therein for giving instruction upto the highest medical degree of the University.

(*c*) That the Corporation should provide the necessary buildings and equip the College with all necessaries for giving proper instruction.

(*d*) That the Corporation should ever afterwards maintain the College and defray the necessary recurring expenditure for the purpose.

(*e*) That the Professors and Teachers to be employed at the College should all be properly qualified independent Indian Gentlemen not in Government service.

(*f*) That the College should be named the "Seth Gordhandas Sunderdas Medical College."

Seeing that the need for another Medical College in the Presidency was keenly felt, the Corporation accepted the munificent offer. A Sub-committee was formed consisting of some of their members, the Municipal Commissioner and the representatives of the Bombay Medical Union, who were very much interested in the establishment of another Medical College in the City.

The Design.—The Hospital, which accommodates 304 beds is designed on the modern pavilion system. A straight corridor runs from north to south with various buildings branching off at right angles. The hospital proper or the main blocks connected to the corridor are as follows:— *In the centre is the* admission and administration block with the kitchen and stores behind and the quarters for the Resident Doctors and an operation theatre on the first floor. There are four ward pavilions.

two on the south side and two on the north side for medical and surgical cases. Each pavilion contains 52 beds. The out-patients' block is on the north. The Gynaecological hospital with a separate entrance of its own and the Ophthalmic Hospital are on the east; so also the Casualty Ward and the Main Operation Theatre. At the southwest corner of the site is the Nurses' Home, a three-storeyed building and connected with the Hospital by a covered way. It provides accommodation for 89 nurses. To the east of the Nurses' Home there is another building which accommodates 13 nurses and is called the "Nurses' Annexe." On the eastern boundary of the site are located the Clinical Pathology Department and Mortuaries connected with the main building by a covered way. An Isolation Ward is also provided. Besides these main buildings, quarters for some members of the staff and servants and a laundry for the hospital are located in the grounds The large out-patients' block with separate entrances for men and women contains departments for up-to-date treatment and diagnosis of ear, nose and throat, dental and skin diseases besides the usual medical, surgical and gynaecological departments. A large X-Ray and Electro-therapeutic department is provided for. With the generous donation of Rs. 25,000 from the Trustees of the N. M. Wadia Charities, Deep Therapy Apparatus has been recently installed for the treatment of patients. The Hospital has a Casualty Department which is open day and night. Arrangements have been made in the department to give immediate treatment to V. D. cases at any time of the day and night.

A new ward for the treatment of venereal cases with an accommodation of 16 beds has been constructed but due to financial stringency it has not been opened as yet.

The College is a handsome three storeyed building designed in the shape of a T with the possibility of future extension by the erection of another three storeyed wing at either end and providing for an increase of 60% on the present accommodation.

The Trustees of the late Seth Jamnadas Lallubhai Charities having donated a sum of Rs. 1,10,000 in Government Securities for the construction of a museum building, a separate museum building has been constructed and is ready for occupation. The necessary equipment is at present being provided for it.

The College has a students' hostel attached to it with an accommodation for about 150 students.

The College has been affiliated permanently to the University of Bombay in the Faculty of Medicine for the purposes of all the examinations for the M. B., B. S. degrees and for postgraduate medical degrees and diplomas and also for the B. Sc. course in animal Physiology, in Microbiology and in Human Anatomy and Embryology.

The cost.—The Hospital and the College buildings have cost in construction considerably more than the original estimates owing to the great increase in prices of all commodities soon after the end of the last War. The Hospital has cost over 50 lakhs of rupees including the value of the free site, and the College about 18 lakhs to construct. In spite of this heavy expenditure, the Municipal Corporation of Bombay have not stinted anything in equipping both the College and the Hospital with the latest appliances, instruments, apparatus, books etc. in all their departments. The cost of equipping the Hospital and College has come to over 8 and 5 lakhs of rupees respectively. The annual recurring expenditure to the Bombay Municipality for the maintenance of the Hospital and the College is about 8 lakhs of rupees.

The Staff.—The administration of the College and the Hospital is in charge of the Dean, who is responsible to the Corporation for their efficient management. Besides the usual teaching staff obtaining in all modern medical colleges, the different departments of the College are directed by four whole time Professors. The Bombay Municipal Corporation have been very fortunate in securing the services of 23 highly qualified Indian Doctors to serve the Hospital and the College in an honorary capacity.

The College and the Hospital were formally opened by Sir Leslie Wilson, Governor of Bombay, on the 22nd January 1926. The College was opened for the admission of medical students in June 1925 and the Hospital was opened for the reception of patients on the 15th February 1926. The present bed accommodation in the Hospital is for 354 patients but the demand for treatment in the Hospital by the sick of the city is so pressing that over and above the maximum number, at least

about 16 to 20 patients have to be accommodated in the wards throughout the year.

V. R. KHANOLKAR.

Bombay Veterinary College.—This institution is maintained by the Government of Bombay and provides a three years' course of instruction in veterinary science. It was established in the year 1886 and it owes its origin largely to the zeal and enthusiasm of the first Principal, Professor J. H. Steel, F. R. C. V. S. Clinical and other facilities are afforded to meet the veterinary educational requirements in the Bai Sakarbai Dinshaw Petit Hospital for Animals which adjoins the college. The college was first located in the Hospital premises; but in the year 1906, in consequence of the increasing want of accommodation, the Bombay Government purchased land adjoining the hospital compound and erected upon it a new college and a students' hostel. The object of the institution is to train competent practitioners for veterinary service under Government, for private practice, for service in Indian States &c. A diploma of graduation is awarded after the completion of the course and on passing the examination The first batch of Graduates passed out in 1889. Improvements and additions to the staff and equipment of the college were made from time to time. Professor Steel died in 1891. He was succeeded by Col. Raymond for a short time. Then followed Col. Mills. He remained as Principal for about 15 years. After the retirement of Col. Mills in 1906, Col. Joslen was made Principal but he died untimely in 1910. Mr. Hewlett succeeded Col. Joslen and continued to be the Principal for about 22 years until his retirement in April 1932. Mr. V. R. Phadke, a graduate of the college, (the present Principal) succeeded Mr. Hewlett.

The college has been in existence now for about 47 years and during this period about 700 graduates passed out. Some of them have distinguished themselves in positions of responsibility and trust in India and elsewhere.

Attached to the college there is a Patho-Bacteriological Laboratory which is mainly being used for diagnostic and teaching purposes. A large number of specimens is received every year from the Civil Veterinary Department in the

Presidency for microscopical examination. Great improvement has been made in the anatomical section of the college. There is also a *Lazaretto* wherein animals suffering from contagious diseases are kept under observation and treated.

V. R. PHADKE.

The University Training Corps–The Ist (Bombay) Battalion.— The University Training Corps owes its origin to the Indian Defence Force, which was formed during the Great War in 1917 for purposes of internal defence. The Corps at present is constituted under the Indian Territorial Force Act of 1920 and is known as the 1st (Bombay) Battalion, University Training Corps (I. T. F.). Similar Battalions are formed in other Indian Universities as well.

The objects of the University Training Corps are more civic than military. It is recognised, that from the military point of view the University Training Corps does not count much. The cadets, who join the Corps have no legal liability to serve, under the provisions of the Act, but from the point of view of the development of character, the training received in the Corps plays a great part. It inculcates in the young men discipline, prompt obedience to commands, self-respect, initiative and quick decision-qualities which are sure to stand them in good stead in their future life. It creates in them a spirit of comradeship and teaches them to rise above the distinctions of caste and creed and to subordinate their self-interest and personality to the interest of their Platoon or Company.

The Bombay University Training Corps consists of one Battalion, which is made up of four Companies. The total strength of all ranks is over 650. Two Companies are stationed in Poona, half a Company at Dharwar and a Company and a half in Bombay. Each Company consist of four Platoons, which are raised on a college basis. Thus the 'C' Company which is stationed in Bombay, is formed by the Platoons drawn from the Elphinstone College (No. 9), the Royal Institute of Science and the Ismail College (No. 10), the Wilson College (No. 11), and Sydenham College of Commerce and Economics (No. 12). This Company is commanded by Lieutenant A. B. Gajendragadkar of the Elphinstone College. The St. Xavier's College supplies

two Platoons, which go to make half of 'D' Company. Each Platoon consists of 32 men, divided into four Sections of eight men each. Sections are commanded by Non-Commissioned Officers. A commissioned officer, who is a member of a College staff, commands a Platoon and is assisted by a Platoon Sergeant. Thus the total strength of a Platoon is 38 including the officer.

The offices of the Adjutant and Commandant are combined in one. Captain H. S. Dean, M. C. is the present Commandant of this Corps.

The Head Quarters of the Corps were originally in Bombay but they were transferred to Poona on account of lack of suitable accommodation in 1923.

Training in the Corps is carried on by means of parades which are usually held twice a week. The training Season begins with the commencement of the academic year of the University, that is, in June and lasts till the end of December. An annual camp of exercise is held about Christmas and lasts for thirteen days. All detachments are concentrated in this camp, which is usually held somewhere near Poona. Before going to camp men complete their musketry training and musketry course.

Students who pass out of the University or leave college for some other reason are automatically discharged from the corps. Thus every year more than half the number of men in a Platoon leaves the Corps and sometimes this number is even greater. New recruits have, therefore, to be admitted and training has to be given to them from the very beginning. The result of this is that training in the Corps is not progressive and cannot go beyond a certain point. Thus a man who has been in the Corps for a year practically learns all that is possible for him to learn and in subsequent years he has nothing new to engage his attention. This, of course, is inevitable owing to the nature of the composition of the Corps. But what little of military training he receives during his two or three years in the Corps has a marked influence on the general bearing of the student. In all about 5,000 students have received such training so far.

The University Training Corps was not very popular in the beginning and considerable difficulty was felt by Platoon Commanders in bringing their Platoons up to strength. But things

have changed since. Our young men have developed a liking for military training and it would not be difficult now to raise even double the present sanctioned strength.

A. B. GAJENDRAGADKAR.

The Bombay Students' Brotherhood.—The Bombay Students' Brotherhood is one of the pioneer associations of the city, helping the growth of corporate feeling and of the habits of serious thought and mutual service among High School and College students. It started in 1889 as a small Sunday Class for moral instruction under the inspiring guidance of Mr. N. G. Welinkar, now in the educational service of H. E. H. the Nizam. The idea caught on and in a few years' time other activities grew round this nucleus, the need for organization was felt and the Students' Brotherhood came to be formed with definite aims and objects. The Sunday Class for the serious study of some thought-provoking book has continued to be held regularly all through the last thirty-five years and more, and men like the late Sir Narayan Chandavarkar have been teachers thereof. Besides that, the Brotherhood conducts a reading-room and library, arranges lectures by men distinguished in literary or public life, organizes debates among its own members and with sister institutions, holds elocution competitions and social gatherings and thus tries in various ways to create a feeling of brotherhood, irrespective of creed or caste and to provide a common platform for young men belonging to various educational institutions of this cosmopolitan city.

The Brotherhood has a large number of members and its present president is Mr. M. R. Jayakar. The office and headquarters are at the Arya Bhavan, Sandhurst Road, Girgaum, Bombay 4.

Social Service League.—This is situated in the Servants of India Society's Home.

The aims and objects of the League are :—

(1) The collection and study of social facts; the discussion of social theories and social problems with a view to ameliorate the physical, moral, mental and economic condition of the people by—

(i) endeavouring to secure better and reasonable conditions of life and work ;

(ii) providing medical relief ;

(iii) spreading the co-operative movement in the form of co-operative societies, co-operative stores, co-operative housing, co-operative insurance ;

(iv) providing education by means of day and night schools and continuation classes for literary and industrial education, lecture series, lantern demonstrations, reading rooms and libraries ;

(v) providing means of recreation such as social clubs, gymnasia, open spaces, week-end excursions, etc ;

(vi) promoting sanitation and hygiene–personal, domestic and public ;

(vii) combating actively the evils of intemperance, gambling, prostitution, and other vices;

(viii) taking measures for the education and reclamation of convicts and criminal classes;

(ix) endeavouring to relieve poverty and distress.

(2) Adoption of measures for the training of social workers.

(3) Adoption of measures for organisation of charities and social work.

The League's present activities may be briefly classified thus :—

(1) Promotion of mass education by means of Night Schools, Libraries and Magic Lantern Lectures ; (2) Boy Scout Corps ; (3) Promotion of public health by (a) provision of medical relief through free dispensaries, (b) Sanitation work in the city, (c) sanitation work in rural tracts by administering the Florence Nightingale Village Sanitation Fund; (4) Work for women ; (5) Work for Released Prisoners ; (6) Supervision of the Belgaum Criminal Tribes Settlement; (7) Spread of Co-operative movement; (8) Securing compensation for workmen for accidents; (9) Recreation for the working classes in the form of fresh air excursions and open air sports. (10) Management of the Indian Gymnasia and Theatricals ; (11) Social Work at Parel Settlement ; (12) Social Work at Madanpura Settlement ; (13) Bombay Working Men's Institute; (14) Propaganda work through the

medium of the Social Service Quarterly, lectures on social subjects, the Social Service Library, the Register of Social Service Institutions and Social Workers Training Classes; (15) Village Reconstruction work and organsiation of Grain Banks in rural areas.

The League maintains 6 night schools of which 5 are primary schools and 1 a high school; a textile technical school; a sewing and cutting class for women; 3 standing libraries and 3 free reading rooms; a free travelling library consisting of Marathi, Gujarathi and Urdu books; a Boy Scout Troop; a charitable dispensary for women and children; gymnasia for workmen; a big hall equipped with stage; an amateur dramatic club for providing cheap recreation to working classes; an open air gymnasium provided by the Municipality and garden with open space. The League supervises the work of co-operative credit societies organised by it and Co-operative Banking Union; arranges sanitation rounds in the city; organises first aid; home nursing; home hygiene; Health Volunteers' classes for women; arranges lantern lectures on various subjects and public lectures on social subjects; helps workmen to obtain compensation due to them for accidents and gives free legal advice to the poor; arranges for writing petitions, complaints etc, on behalf of the poor; organises excursions and sports for the working class children; maintains an information bureau, a register of charities; publishes an English Quarterly, Directories of Social Institutions and pamphlets on social subjects; and organises classes for the training of social workers. The League's Library at the Head Office consists of 1,692, books, 1,780 pamphlets and 40 periodicals on social and labour questions.

Fellowship School, (China Baug, Girgaon Back Road, Bombay.) This co-educational institution was founded on the 10th June 1927 for the realisation of modern ideals in Education. It is a non-sectarian school, giving to students opportunities for creative self-expression and for the cultivation of wholesome citizenship. " Service to Man is an expression of the Love of God " is the dominant aspect of the religious education imparted in this school.

The School runs three departments—Montessori, Primary and Secondary, and children are admitted from the age of 2½ upwards. The School runs Art and Music departments. A system of self-government is introduced whereby the pupils are actively associated with the conduct of the school. Medical and Dental inspections are periodically held. Doctors give talks on First Aid and Personal Hygiene. There is a whole time Physical Culture teacher and Physical culture periods form part of the regular time-table. Scouting, Girl-Guiding, Blue Birds and Cubbing have been introduced into the school.

New Era School. (*Tanker-Ville, Gowalia Tank, Bombay*)—This is a co-educational institution, first of its kind, to practise the new ideals and methods of education. It admits children from the age of 2½, and prepares them for the Bombay Matriculation Examination. It practises the Montessori, the Kindergarten, the Dalton and Project plans and methods with necessary modifications. Besides the usual curricular subjects, the school specialises in the teaching of Music, instrumental and vocal and Drawing and Painting which are in charge of gifted artists. Special attention is paid to Physical Education and extra-curricular activites such as scouting, girl-guiding, recitations, school debates, theatrical concerts, excursions, lantern lectures, gramophone recitals, etc.

The Bombay Young Men's Christian Association was founded in 1874 in rented rooms in Kalbadevi with a foundation membership of 150, chiefly Europeans. The Association has now four well-equipped buildings (*a*) in Wodehouse Road, Fort, serving principally young Europeans, (*b*) in Lamington Road, Girgaum, entirely devoted to work among Indian students, (*c*) in Rebsch Street, Byculla, devoted to the service of Anglo-Indian apprentices and other youths and (*d*) at Reynolds Road, Byculla, providing a centre for young Indian business and professional men and senior students. The buildings provide hostel accommodation for 200 young men and have a membership of 1,000. A regular programme of educational, social, physical and religious work is carried on in each centre, including lectures by prominent educationists, classes, debates, study-circles, gymnasia, sports and athletics, concer[illegible]ial and religious meetings, etc.

The Association has recently organised a demonstration centre in Social Welfare Service for industrial workers and their families, living in the new Development-Directorate Chawls at Naigaum, which includes evening classes, organised mass games, First-aid, lantern lectures on health and other subjects and special activities for women and girls. This centre provides a clinic for social service training for students and other members of the various Y. M. C. A. branches.

Another development during the present year has been the organisation of a City Physical Department which in addition to promoting a physical programme in each of the Y. M. C. A. Branches is conducting two demonstration playgrounds thoroughly equipped and supervised, in congested areas, at the special request of the City Corporation. It is co-operating with the education authorities in the promotion of scientific physical education in the schools of the Presidency and the training in physical work of picked teachers from the High Schools. It is also co-operating with the University in promoting a Physical Education programme in the various Colleges.

HOSPITALS.

St. George's Hospital.—The first hospital for "Sick English" in Bombay was established in 1677 by Gerald Aungier on the Esplanade near the Cooperage, but transferred to a building opposite the Great Western Hotel building in 1733, and was the General Hospital for Europeans in both military and civil employ. In 1824 the hospital was transferred to Hornby Road, where as a number of thatched buildings it occupied a site near the Sir Jamsetji Jijibhoy Parsi Benevolent School, and continued to be in use until 1860 when it was condemned by the medical authorities. It was thereafter temporarily located in the European Artillery Barracks in Fort George. The foundation stone of the present hospital—named St. George's Hospital—which is to the east of the Victoria Terminus Station, was laid by Lord Reay in 1889. It has general and special wards and is equipped in an up-to-date manner.

The St. George's Hospital Nursing Association provides a large staff of nurses for the hospital and also for private outdoor work.

Sir Jamsetji Jijibhoy Hospital.—The Hospital was built in 1843 at the joint expense of Sir Jamsetji Jijibhoy, the first baronet, and the East India Company, and is situated near the junction of Parel and Babula Tank roads. It was designed to afford medical relief to the poor Indian population of all classes. There is accommodation for 350 beds, with detached buildings for Parsi male patients and for chronic cases. A fine operation block has been added to the Hospital and is known as the "Moore Operation Theatre."

The New Hospital for Children known as Byramjee Jeejeebhoy Hospital for Children was built in 1928-29, and two fine buildings viz. the Ellappa Balaram Pavilion and Sassoon David Hospital were built in the year 1928-29.

Cowasji Jehangir Ophthalmic Hospital.—Adjoins the J. J. Hospital and was originally built in 1866, but has lately been considerably enlarged.

Bai Motlabai Obstetric Hospital and *Petit Hospital for Women and Children* are situated to the east of the J. J. Hospital. These institutions were opened in 1892.

The J. J. Hospital and the adjoining special hospitals mentioned above form the principal centre for clinical instruction in connection with the Grant Medical College; they are all exceedingly well equipped for the purpose of imparting practical knowledge to the medical students. A Nursing Association under the charge of the Sisters of All Saints provides an excellent nursing staff for these hospitals, and also for private cases outside.

King Edward VII Memorial Hospital was opened up as a 'Hospital in the Northern part of the Island" and as "the most fitting memorial to His late Majesty." This excellently equipped hospital in almost all branches is attached to the Seth Gordhandas Sunderdas Medical College, which started its activies only recently (See special article on page 58).

The Gokuldas Tejpal Hospital is situated on the Carnac

Road, and the *Cama* and *Albless Hospitals*, which are for female patients only, on Cruickshank Road.

Of the *Military Hospitals* the *Station Hospital* for European troops and officers is situated at Colaba, while the *Marine Lines Hospital* is for Indian troops.

S. L. BHATIA

The Municipality maintains a hospital for the treatment of Infectious Diseases called the *Infectious Diseases Hospital* which is situated at Arthur Road near Jacob Circle. All cases of infectious diseases are removed to this hospital for isolation and treatment.

Acworth Leper Asylum.—This asylum is located at Matunga about 1½ miles to the north of the Bombay Bacteriological Laboratory. The private road to the Asylum branches off Matunga Road and the Roman Catholic Chapel of Wadala is a few yards away from it. The institution was opened in 1891 and is situated in a neat little garden and accommodates about 350 lepers. The inmates are located in wards most of which are old and stand upon the foundations of artillery barracks which in olden times had to be abandoned on account of the prevalence of guineaworm disease among the artillery men. The old wards however are being gradually replaced by more up-to-date ones. In the compound are Protestant and Roman Catholic Churches, a Hindu Temple and a Muhammadan Mosque for religious observances on the part of the inmates.

Attached to the Asylum is a successful sewage farm. All sewage from the Asylum buildings is conveyed by means of a water carriage system to a "Septic" tank where it settles, the solids undergoing disintegration while the supernatant fluid, which is full of nitrites and nitrates, passes on as effluent which is utilized on land for growing crops of Maize and Jowar which are sold as fodder for animals. The marsh gas given off during the process of disintegration of the sewage was at one time utilised for working a small gas engine, cooking and for lighting the compound. This installation, however, has now been done away with. An electric motor and a small engine worked with oil, pumps the effluent up into a storage tank from which it is distributed by means of channels all over the farm. The

effluent if purified still further by passing it through filters, of which there are various patterns, comes out as a clear, odourless and sparkling fluid.

Bombay Sanitary Association.—This association was founded in 1904 to (1) create an educated public opinion with regard to sanitary matters in general ; (2) to diffuse the knowledge of sanitation and hygiene generally and of the prevention of the spread of diseases amongst all classes of people by means of lectures, leaflets and practical demonstrations, and if possible, by holding classes and examinations ; (3) to promote sanitary science by giving prizes, rewards or medals to those who may by diligent application add to our knowledge in Sanitary Science by original research or otherwise ; (4) to arrange for homely talks or simple practical lectures for mothers and girls in various localities and different chawls.

The Association has now a building of its own — The Sanitary Institute – at Princess Street, provided with a Lecture Room, a Class Room and a Museum of Sanitary Appliances. Popular lectures and practical demonstrations are given from time to time by distinguished persons on subjects connected with Sanitation, Hygiene and various diseases.

Under the auspices of Lady Willingdon a scheme had been inaugurated for securing proper treatment for poor women during confinement and proper care of their infants at birth. Three hospitals have already been opened for the purpose and have been doing excellent work.

The Nowrosjee Wadia Maternity Hospital.—The Midwifery Commission, appointed by the General Medical Council, London, first came to Bombay in the beginning of the year 1922 to inquire into the facilities for Midwifery training in India and report to the Council the then existing deficiencies and measures to be adopted for removing the same. Dr. Mangaldas V. Mehta, one of the members of that Commission for Bombay Presidency, very clearly pointed out to Sir Norman Walker that a large portion (55 to 60 percent.) of women of the mill labourers was migrating to their native places for confinement, and if a central maternity hospital was opened in Parel, the centre of the mill area in Bombay, this large material

would be available for giving medical relief to the poor and needy labour class women, and later on giving the final year students of the Medical Colleges in Bombay, facilities for completing their 20 labour cases required by the University. A rough scheme of this was given to Sir Norman Walker, and after the return of this Commission to England, Dr. Mehta with Lt. Col. Liston and Dr. Row, had an interview with Sir Ness Wadia, the head of the Firm of Messrs. Nowrosjee Wadia and Sons and one of the mill magnates of Bombay. On pointing out to him the great necessity of establishing a Maternity Hospital, he very willingly agreed to the proposal and offered to finance the scheme as an experiment.

Accordingly the Nowrosjee Wadia Maternity Hospital was started with 6 beds in a hired flat on the top floor of a building in Parel, in September 1922, and within 6 months all the six beds were full. On representing this matter to Sir Ness Wadia, he agreed to hire a whole building with three floors ("Vasant Building" at Parel, Opposite G. I. P. Rly. Workshop) and to fit it out with an accommodation for 30 beds and a ward of 5 beds for antenatal cases with an antenatal out-patients' clinic, which was carried on till the end of 1926. The experiment proved very successful beyond expectations and by the beginning of 1925 could not be accommodated all the patients, who sought admission to the Home. This demand for accommodation was very surprising, particularly in view of the fact that the women of the working class being ignorant and illiterate and bound down by their time-worn customs and prejudices, could be persuaded to leave their own dwellings and avail themselves of the facilities of a Modern Maternity Hospital. The success of the Maternity Home was to a great extent the result of co-operation of the better paid mill jobbers who were called in a conference by Dr. Mehta for explaining to them why the Maternity Home was started and for enlisting their sympathy and support for the Institution. Immediately they had notices put up in various mills acquainting the women of the establishment of this Hospital, exhorting them to go to this Hospital for confinement and actually taking over batches of 25 women workers in the different mills in Bombay, every Saturday and Sunday to see the Home for themselves. It was only on this account that

the temporary Maternity Home became very popular, more especially as women who had taken full advantage of this Hospital and had successfully come through the trials and sufferings of Maternity, spread news of the good work done and the kindly treatment meted out at this Home.

Sir Ness Wadia chose to start this Maternity Home at Parel for the following reasons:—

(1) The Institution was mainly intended for the mill labourers.

(2) This locality was in the heart of workmen's homes and because of the gross ignorance and illiteracy, " what is out of sight is out of mind " for them.

(3) The Island of Bombay has been growing more towards the North and this part of the city was thickly populated, the Improvement Trust and Development Departments having put here several new chawls for the working class.

With the progress of this experiment great anxiety was caused as to how to cope with the rush in the Home which necessitated certain restrictions of further fresh admissions.

In 1923 Sir Ness Wadia being satisfied with the experiment made an offer to His Excellency Sir George Lloyd, the then Governor of Bombay, to put the Hospital on a permanent basis, but the offer was declined because Baron Lloyd was anxious rather to extend the J. J. Hospital than to build new ones. This offer was repeated to His Excellency Sir Lesie Wilson, later Governor of Bombay, on a somewhat enlarged scale in the year 1924 and by the end of that year the scheme to establish this Hospital on a permanent basis was adopted.

This scheme required the co-operation of the Bombay Government and the Municipal Corporation which was willingly accorded. The land acquired, about 19,954 square yards, was taken by Government from the Improvement Trust opposite the Gordhandas Sunderdas Medical College and close to the Haffkine Institute and handed over to Sir Ness Wadia for building thereon a Hospital for 120 beds with proper nursing quarters, etc. The design of the building is by the well-known architect of Bombay, the late Mr. George Wittet. The estimate

for the complete Hospital was 16 lakhs; rupees 3 lakhs for the land, rupees 12 lakhs for building and 1 lakh for furniture and equipment. The building was completed in the record time of 17 months taking into consideration two rainy seasons intervening. Sir Ness Wadia's share in the 16 lakhs for building is 6 lakhs while that of the Government and the Municipality is 5 lakhs each. In addition to this Sir Ness Wadia's contribution towards the Endowment Fund is Rs. 60,000 per year. The Government and the Municipality contribute Rs. 35000 each per year thus making up the total of Rs. 1,30,000 a year for the maintenance of the Hospital of 120 beds.

The Hospital is under the control of a Board of Management consisting of two representatives of Government, two of the Bombay Municipality, two of the Bombay Mill-owners' Association and three from the Firm of Messrs. Nowrosjee Wadia & Sons; this Board has practically full responsibility with regard to all details in connection with the running of the Hospital. This is quite a new departure in hospital management; this Hospital is independent of any other Institution in Bombay and is run entirely under the control of the Board of Management.

The Board of Management have agreed to give facilities for admitting the students of Grant Medical College and the Gordhandas Sundardas Medical College to conduct maternity cases under the supervision of qualified medical graduates according to rules framed by the Board.

The Hospital was declared open by His Excellency Sir Leslie Orme Wilson, the then Governor of Bombay, on 13th December 1926. It was founded to commemorate the memory of the late Hon. Mr. Nowrosjee N. Wadia on the 27th Anniversary of his death, the founder of the Firm of Messrs. Nowrosjee Wadia & Sons.

The establishment of a permanent Maternity Hospital of 120 beds in the heart of the mill area in Bombay has proved beyond doubt a crying need, and the thanks and silent blessings of the women will go out in full measure to him who has had the generosity and foresight to provide this necessity which will be

the means of saving many thousands of lives of women and infants in the future, and alleviating the sufferings of mothers.

It is most surprising that during the very first year all the 120 beds were occupied, still more emphasising what a great need there was for a Maternity Hospital in this area.

Below are given figures of births in the Hospital from the very start :

Year	*No. of confinements:*
Sept. 1922 to Dec. 1923	311
1924	677
1925	979
1926	1331
1927	2335
1928	3051
1929	3371
1930	4110
1931	4467
1932	4321

In this Hospital more attention is concentrated on the antenatal work and as far possible women are being educated to register for a bed in the Hospital for confinement from the 7th month onwards and even during the earlier months of pregnancy for advice etc. This Antenatal Out-patients' Clinic is open daily except Sundays.

In the year 1929, 30 more beds were added thus increasing the accommodation to a total of 150 beds; out of these 2 wards of 14 beds each were set apart for Paying Patients.

DISTRIBUTION OF NUMBER OF BEDS IS AS UNDER.

Lying-in beds	70
Septic beds	14
Antenatal & Waiting beds	20
Recovery beds	10
Labour ward beds	8
	122
Paying beds ...	28
	150

Dr. Mangaldas V. Mehta is the Honorary Principal Medical Officer since 1922, i. e. from the very beginning, and Dr. N. A. Purandare M. D., F. C. P. S. and Dr. H. D'Sa. M. D., F.C. P. S. lecturers in Midwifery at the Seth Gordhandas Sunderdas Medical College, have been working as Honorary Visiting Obstetricians from 1927.

The city of Bombay stands in the forefront in the whole of India, for the fact that 75% of the total births in the city are in Maternity Institutions. This record will stand comparison with any city in Europe or any other continent.

M. V. MEHTA.

The *Bai Yamunabai L. Nair Charitable Hospital* was started by Dr. A. L. Nair in memory of his late mother, Bai Yamunabai. The scheme of the Hospital was privately conceived by him and a foundation stone for the same was laid in April 1923 on the birthday anniversary of Lord Buddha. A fine building with all sanitary arrangements was next built and a modest opening ceremony was performed on 7th May 1925. In this Hospital free medical and surgical aid of every kind is given to the poor, irrespective of caste, creed or colour. It has been affiliated to the National Medical College as a teaching unit and this is the third teaching hospital in the City of Bombay.

This Hospital soon became popular and the number of patients began to increase. Therefore, in the year 1930, Dr. Nair built a separate building for the Out-door Department and handed it over to the Trustees. Now the Hospital has 72 beds and the daily average of outdoor patients is more than 200. At present this Hospital is receiving patients from every Ward of the City and even from outside Bombay. The popularity won by this Hospital within such a short time clearly proves the good work that is being done there. It is worth mentioning here that the Hospital has a highly qualified staff and all the Surgeons and Physicians are rendering honorary service for such a noble cause. The public of Bombay are very fortunate in having such an up-to-date and splendid hospital for this City.

M. VENKATRAO.

TUBERCULOSIS.

King George V Anti-Tuberculosis League.—In 1912, a League called *'King George V Anti-Tuberculosis League'* was organised to establish special measures for the prevention of tuberculosis in its varied manifestations. The work of this League was subsequently taken over by the Bombay Municipality with its two dispensaries and one sanatorium, called ' Turner Sanatorium. '

The Municipal campaign against tuberculosis in Bombay includes the following measures which are best suited to local conditions and requirements :—

(1) Compulsory notification of the disease

(2) Tuberculosis dispensaries— Two

(3) Sanatorium for early cases of Tuberculosis

(4) Tuberculosis Hospital for advanced cases

(5) Surgical cases requiring operative treatment accommodated at the Municipal General (K. E. M.) Hospital.

(6) Medical inspection of school children

(7) Supervision of milk and food supplies

(8) Special allowance for the support of family of necessitous patients

(9) Examination of contacts at the dispensaries

(10) Educational propaganda in co-operation with the Bombay Sanitary Association and also by house to house visiting by qualified nurses attached to the dispensaries.

At present, the Bombay Municipality has under its control two anti-tuberculosis dispensaries, one Sanatorium and a Hospital for the advanced cases. The dispensaries are situated one at Princess Street and the other at Foras Road. The Sanatorium is situated in the north of the island at Bhoiwada Hill, Parel, on a small hillock with extensive open grounds and has accommodation for 32 patients in early stages of the disease. The Maratha Hospital at Connaught Road to the north of Victoria Gardens has 80 beds for advanced cases.

J. S. NERURKER.

VENEREAL DISEASES.

The League for combating Venereal Diseases.–This was founded under the auspices of the Bombay Sanitary Association in 1917 with the following aims and objects:—(1) to disseminate knowledge for the prevention and cure of venereal diseases and to provide accurate and enlightened information as to their prevalence; (2) to promote the provision of greater facilities for their modern treatment; (3) to increase the opportunities of medical students and practitioners for the study of these diseases; (4) to encourage and assist the dissemination of a sound knowledge of the physiological laws of life in order to raise the standard both of health and conduct; (5) to co-operate with existing associations to seek their approval and support and to give advice when desired; (6) to arrange for courses of lectures etc., and to publish suitable literature; and (7) to promote such legislative, social and administrative reforms as are relevant to the foregoing aims and objects.

The League had an Information Bureau and Dispensary at 66, Lamington Road, well equipped with all the necessaries for free diagnosis and treatment of venereal diseases with a staff of a Medical Officer and a Lady Physician.

The work of the League was transferred to the Bombay Municipality in the year 1925, and the dispensary has now been shifted to No. 266, Bellasis Road.

J. S. NERURKAR.

MUSEUMS.

The Royal Asiatic Society's Museum is located in the Town Hall and was opened in 1816 for the collection and preservation of antiquities and specimens of the natural history, arts, and mythology of the East. It contains a priceless collection of archæological relics, and carvings, inscriptions and copper plate of great interest. Notable among the collection is a stone coffer found at Sopara in Salsette, containing relics of Buddha; it is seen at the west end of the main Reading Room of the Society's Library. The Library possesses a large collection of invaluable Oriental Manuscripts, and the museum also contains the charts and survey maps which once belonged to the Bombay Geographical Society, which was amalgamated with the Royal Asiatic

Society in 1873. A number of specimens of geological and geographical interest, presented by the Bombay Anthropological Society in 1896, are now located in the Prince of Wales Museum. The museum also owns a number of ancient gold, silver and copper coins found in various parts of India.

The Victoria and Albert Museum is located in the Victoria Gardens at Byculla and was founded in 1858. The collection was originally commenced in 1848 and was at first lodged in the Mess Rooms of the old Town Barracks. But in 1857 on the outbreak of the Mutiny, the military authorities urgently required these rooms, and during the work of removal the specimens were either damaged, destroyed, or lost. The remnants were next lodged in the Town Hall where they remained uncared for until finally removed to the present building in 1872. The Victoria and Albert Museum is built in the Italian Renaissance style; the interior is highly ornamental, but the fine ceiling has been spoilt by letting into it two unsightly sky-lights. The collection consists of all kinds of indigenous economic products and a few natural history specimens. The "Old Bombay" rooms contain an interesting collection of prints, drawings, maps and photos of old Bombay of which a catalogue can be obtained in the Museum.

The Natural History Museum was originally founded by the Bombay Natural History Society in 1883. The Museum contains a large collection of mammals, birds, reptiles, fishes and invertebrates, snakes, lizards, small animals, insects, marine and land shells, fishes, birds' eggs and a herbarium. It also owns a fine collection of heads and skulls of Indian mammals.

These collections are now housed in the Prince of Wales Museum. The research collections continue to be kept at 6. Apollo Street.

The Museum of the Sanitary Association and of the Anti-Tuberculosis League are located in the building of the Sanitary Institute in Princess Street and contain models, charts and drawings in connection with Sanitation and Public Health, and photographs, specimens, appliances and models for the education of the public in the matter of prevention of Tuberculosis.

PRINCE OF WALES MUSEUM OF WESTERN INDIA.

Building.—Fronting the Council Hall, the Royal Institute of Science and the Elphinstone College, and butting on Rampart Row to the north, stands the magnificent domed building in Indo-Saracenic style, called the Prince of Wales Museum of Western India. This building is a permanent memorial of the visit in 1905 of their Royal Highnesses the Prince and Princess of Wales. Though the question of providing Bombay with a Museum had been discussed in earlier years, the history of the Prince of Wales Museum may be said to begin with the appointment by Government in 1904 of a committee to investigate the subject.

Donations—In connection with the Royal visit and in furtherance of the desire of the public for a Museum, several liberal contributions were received from the distinguished citizens and institutions of Bombay Presidency. The then Mr. Currimbhoy Ibrahim, made a gift of Rs. 3,00,000, Government granted Rs. 3,00,000, His Highness the Nawab of Junagadh donated Rs. 12,000, Sir Cowasji Jehangir gave Rs. 50,000, the Corporation contributed Rs. 3,58,000 in Government Securities; and Government and the Corporation have also been making further grants subsequently.

Design of the Building.—The present block was designed and built by Mr. Wittet (then Consulting Architect to Government). This building is one of the three blocks which made up the original design and was completed in 1914.

Management.—The management and maintenance of the Museum has been entrusted to a Board of Trustees under the Prince of Wales Museum Act III of 1909. The Museum is maintained from annual grants made by Government and the Corporation.

Opening of the Museum.—The building was used during the War as a Military Hospital and came into the possession of the Trustees for Museum purposes only in 1920. After the collections had been assembled and the show-cases made, the opening ceremony was performed by Her Excellency the Honourable Lady Lloyd on January 10th, 1923, when the three main sections

namely, Art, Archæology and Natural History, were thrown open to the public.

Growth of Sections:—These Sections have continued to grow and flourish since the opening date, and to-day they are visited by many learned and distinguished persons, by students, and others, to whom they furnish a wide field of instruction and interest, while the staff of the Sections are engaged in the process of mounting specimens, arranging, classifying, labelling and cataloguing exhibits.

Art Section.—The most attractive Department of the Museum is the Art Section containing the valuable collection of a pleasing variety of pictures and 'objects d' Art' such as ceramic, jade, brass, crystal. silver, arms, drapery, etc., bequeathed by the late Sir Ratan Tata, a collection of pictures, statuary, etc., presented by Sir Dorab Tata, and a collection of Mughal pictures and Maratha relics obtained by purchase. The fact that the Sir Ratan Tata Collections were made available to the public so soon is due to the generosity and public spirit of Lady Ratan Tata, whose benefactions to the Museum have been numerous and munificent and who always continued to maintain her keen interest in the Museum.

Archæological Section.—The Archæological Section comprises a Brahmanical Gallery, a Jain, Pre-historic and Foreign Antiquities Gallery, a Buddhist Gallery and an Epigraphical Section. It includes the loan collection of the Bombay Branch of the Royal Asiatic Society, specimens lent by the Director-General of Archæology and a few specimens received as gifts. There is also a large and interesting collection of coins.

Natural History Section.—The Natural History Section consists of the Bombay Natural History Society's valuable and interesting collections of Mammals, Birds, Reptiles, Amphibians, Fish and Invertebrates. The exhibits on view in the Section do credit to the Taxidermy Department.

Forest Specimens.—There are also a few specimens illustrating the forest resources of the Bombay Presidency and their commercial possibilities.

Minerals.—Mr. J. Ribeiro's collection of the minerals of Bombay Island is also on view.

Garden and Grounds:—The garden and grounds are a source of pleasure to the public and take their modest share in forming a lung of the city, in that they form a suitable place with their flower-beds, lawns, sand-pit, shrubbery and fernery, for the recreation and enjoyment of children and adults.

Appeal for funds.—The Museum also requires additional space and funds for the furtherance of its activities and growth. The limited accommodation in the existing building and the inadequate funds at the disposal of the Board have proved to be the main hindrances to the expansion of each of the Sections. The Board, however, trust that as the importance of having a fully developed Museum comes to be realised by the public. more public funds, donations, and bequests by the wealthy, such as are commonly made to similar institutions in Europe and America, will be forthcoming, so that additional accommodation can be provided and equipped and funds for the increasing expenses provided.

The Museum is ordinarily open to the public on all the days of the week except Monday, from 10 A. M. to 5-30 or 6 P. M. (S. T.). Admission is Free except on Wednesday when a small fee for admission is charged. On Monday the Museum is entirely closed to visitors.

S. H. PRATER.

PLACES OF WORSHIP.

PROTESTANT CHURCHES.

St. Thomas' Cathedral.—The work of building this church was started in 1676 with a fund of Rs. 50,000 chiefly contributed by the Company's servants who " came forward freely and conscientiously offering one year's wages, some half a year's and the least a quarter ". After the walls of the building had risen to a height of 15 feet, it was discovered that the funds had mysteriously disappeared and it was noised that some one in high authority had misappropriated them for his own use' And then, for a period of nearly 40 years, the bare walls remained a prowling place for " dogs, bandicoots and badmashes of all sorts " during the day and jackals at night. This scandalous state of affairs was removed by the arrival of the Rev. Richard

Cobb, Chaplain to the East India Company, who in 1715 made a stirring appeal "to wipe away the reproach of being godless in the sight of the heathen" and to complete the ruinous edifice. The result was that fresh subscriptions were collected, the foundation stone of a new edifice was laid and on Christmas Day 1718 Governor Charles Boone opened it in state naming it St. James' Church. In 1816 it was consecrated by Dr. Middleton, the first Anglican Bishop in India, in the name of St. Thomas the Apostle. In 1833 Bombay was raised to the dignity of a Bishopric and its first Bishop Dr. Carr was installed in 1838. The Church thenceforth became St. Thomas' Cathedral, and to commemorate the event the old belfry was replaced by the present tower and the clock.

The Cathedral contains a number of fine monuments of historical interest. The three upper clerestory windows were erected to the memory of Michael Scott, a merchant, and the five lancet windows to the officers of the Royal Engineers. The muniment chest contains a silver chalice presented by Aungier to the Christian community of Bombay in 1673.

The Christ Church at Byculla is the second oldest church on the Island; it was opened in 1833 and consecrated in 1835.

The Church of St. John the Evangelist, better known as the *Afghan Memorial Church*, is at Colaba and was built in 1857 in memory of the officers, non-commissioned officers, and private soldiers who died in the campaign of Sind and Afghanistan in 1838–43.

All Saints' Church which is prettily situated in a little open garden near the Malabar Hill Reservoir was consecrated in 1882.

St. Andrew's Church stands near the Great Western Hotel building, and was opened in 1819, while the *United Free Church of Scotland* is in Waudby Road.

ROMAN CATHOLIC CHURCHES.

When Bombay was ceded by the Portuguese, the Chief Roman Catholic Churches on the Islands were those of *N. S. de Esperanca* on the Esplanade, *N. S. Senhora de Gloria* at Mazagon, *N. S. de Salvacao* at Dadar, *San Miguel* at Upper Mahim, and also church at Parel on the site of the old Government House.

but the name of whose patron saint is not known. Of these the N. S. de Esperanca had to be removed from its original site on the Esplanade in 1760 on account of its coming in the way of the guns from the fort ramparts, and in its place the present church in Kalbadevi was erected at the expense of the Government. The Church at Parel, after serving as the Old Government House, is the Bombay Bacteriological Laboratory, now known as Haffkine Institute. The Church of N. S. de Gloria has lately been removed from Mazagon and erected at Byculla. Of the new churches that of the Holy Name built in 1905 is in Wodehouse Road, while St. Ignatius' Church is at Jacob's Circle.

FIRE TEMPLES.

Fire is the chief object of veneration among the Parsis, and the Fire Temple is their public place of worship. The chief Fire Temples are known as Atash Behrams in which is worshipped the fire of Behrams composed of 16 kinds of fire. There are four Atash Behrams in Bombay. The fire kept in a Fire Temple called the Agiari is known as the Atash Adran.

The oldest chief Fire Temple in Bombay is the Dadysett's Atash Behram in Girgaum, which was consecrated in 1783 according to Kadmi rites; while Wadia's Atash Behram at Princess Street was consecrated according to Shehenshahi rites in 1830. The first Agiary founded was the Fort Agiary in 1730; the second Agiary was also built in the same district and dates from 1733.

MOSQUES.

The Muhammadan community of Bombay possesses a number of mosques of which the most noteworthy are:—The Juma Masjid in Sheikh Memon Street; the Jackeria Masjid in Mandvi: Ismail Habib Masjid near Memonwada, and the Mogul Masjid near the Jail Road; the Bohra Masjid is near the Juma Masjid and there is a masjid near the tomb of Makhtum Shah at Mahim.

The Juma Masjid.—The original Juma Mosque of Bombay was built by Konkani Muhammadans but the date is not known. It was situated near the old "Dongary" Fort but was removed during the administration of Mr. Bourchier (1750–60) and erect-

ed on the Esplanade in front of the shrine of Pedro Shah near the Victoria Terminus Station. In 1771 this mosque also had to be dismantled by the order of Governor Hornby which forbade the existence of any building within 600 yards of the walls of the Fort. The present Juma Masjid is situated in Sheikh Memon Street, and has been in use since 1802; it is built over an ancient tank.

The Mahim Shrine.—This shrine and mosque were erected in honour of a Muhammadan Pir or Saint named Makhtum Fakir Ali Paru who died at Mahim in 1431. The saint was of Arab origin and had acquired a great reputation for piety and learning during his life-time. Close by is a very ancient step-well probably belonging to the time of Raja Bimb. A great fair is held annually at Mahim in honour of this Pir.

TEMPLES.

Mumbadevi Temple.—The original Mumbadevi temple from which Bombay derives her name stood near the Victoria Terminus, and was a shrine of the aboriginal fishermen who inhabited these islands. This temple had to be demolished in 1737 for enlarging the fortifications, and a new temple was erected under the orders of Government on the present site at Mumbadevi This temple enclosure now contains a number of other shrines and a large tank which has been built subsequently.

Walkeshwar Temple.—The original Walkeshwar temple was built at the extreme point of Malabar Hill by the Silahar rulers of the Northern Konkan probably in the eleventh century, and it was this temple and the Shrigundi or the Holy Rock, which stood in the sea close by, which first made Bombay famous as a place of pilgrimage among the people of Malabar—hence the name Malabar Hill. This original Walkeshwar temple was destroyed either by the Muhammadans or the Portuguese but a temple built in 1060 by the same rulers at Ambarnath near Kalyan exists to this day. The present Walkeshwar Temple is situated near the Walkeshwar Village and was built in 1717; in front of it is a sacred tank called Bānagangā which is an important place of pilgrimage in Western India. The name is derived from *Walukeshwar* meaning Sand-god.

Babulnath Temple.- This is picturesquely situated on the eastern side of Malabar Hill and is a recent structure completed in 1900. The original Babulnath was built about the year 1780.

Mahaluxmi Temple at Breach Candy is a simple shrine which was built by the contractor of the Hornby Vellard. Near by stands *Dhakji's Temple*, a prominent structure, which is visible twentyfive miles out at sea.

Prabhadevi Temple.—The original temple was built by Raja Bimb of Mahim in honour of his family goddess, but was destroyed by the Muhammadans when they conquered Mahim. The present temple which is on the Prabhadevi Road at Mahim was according to the inscription on the temple wall, built " by the entire Prabhu Community " in the year 1714.

Other Places of Worship.—There are Synagogues in the Fort and Byculla districts. A *Bene-Israel* Synagogue in Mandvi dates from 1796.

The Theistic Church of the Bombay Prarthana Samaj is in Girgaum.

SCIENTIFIC AND TECHNICAL.

BOMBAY BACTERIOLOGICAL LABORATORY.

This is called the Haffkine Institute after its founder. The laboratories have always been the principal centre of bacteriological work of every kind and its activities are described in some detail in a special article.

COLABA AND ALIBAG OBSERVATORIES.

It was in the year 1823 that the present site of the Colaba Observatory was selected and the ground enclosed under the direction of the East India Company. The main building was erected in 1826 under the supervision of Mr. Curnin, the first Astronomer at Bombay. The first fifteen years were marked by a period of inactivity. The instruments supplied to Mr. Curnin were found defective and shipped back to England. In 1835, the Observatory was assigned as a dwelling house to Mr. Orlebar, Professor of Astronomy in the Elphinstone College, and a few instruments were placed at his disposal. No meteorological or magnetical observations taken before 1841 are

however on record. On the recommendation of the Royal Society systematic observations began in that year and the Observatory was associated in the prosecution of research in meteorology and magnetism (besides continuing its astronomical work) with the colonial observatories of Toronto, Habarton, St. Helena, Singapore, the Cape of Good Hope, and with the Indian Observatories at Simla and Madras. From this year the active life of the Observatory may be said to have commenced. In 1842, Mr. Orlebar was succeeded by Dr. Buist. but the appointment of Astronomer at the Observatory was subsequently held by officers of Her Majesty's Navy stationed at Bombay. This arrangement continued till 1864, during which period continuous records of astronomical, magnetical and meteorological observations were secured. But the work was not wholly satisfactory: the generally defective condition of the equipment of the Observatory resulted in the appointment by Government of a committee of inquiry which, after a full investigation, recommended that (1) a full equipment comprising the latest type of recording instruments should be procured, and (2) a full time and fully qualified officer should be appointed as Director. These recommendations were at once acted upon, and Mr. C. Chambers, F. R. S. was selected as the first Director in 1865. The change thus initiated has more than fulfilled the anticipations which were then formed regarding the utility of the Observatory, which now claims to be recognised as a first class Institution with well-established reputation in the scientific world. Both the magnetical and meteorological branches were, as recommended, fully equipped with photographic and mechanically self-recording instruments and with other auxiliary instruments for eye observations. The activity of the Observatory under Mr. Chambers' regime is apparent from the papers published by him in scientific journals and the volumes issued by the Observatory during the years 1865 to 1894, which contain valuable contributions to the science of meteorology and magnetism. On the death of Mr. Chambers in February 1896, Dr. N. A. F. Moos was appointed to fill the vacancy.

In view of a general scheme for the imperialization of the Indian Observatories submitted to the Government of India

which recommended the reduction of the Bombay Observatory to a second class Observatory making it only a recording station, the Secretary of State in 1898 deputed the Astronomer Royal Sir W. Christie and Sir Norman Lockyer to inspect the Observatory and submit a report. As a result of their visit, the Bombay Observatory, which had upto then worked independently under the control of the Bombay Government, was transferred to the Government of India and placed under the administrative control of the Director-General of Observatories. It was decided that the Observatory should continue as a first class Institution and should not be reduced to a mere recording Institution.

In connection with the International scheme initiated by the British Association for the Advancement of Science for the prosecution of enquiry in the science of seismology, the Observatory was selected as one of the Institutions for partaking in this activity.

Early in 1900, when the city of Bombay decided to employ electricity as motive power for its street car service, it became necessary to remove the magnetic work from Colaba to a place free from artificial disturbances and a new Magnetic Observatory was consequently built at Alibag some 18 miles to the south-east of Bombay. It was far away, enough to be beyond the disturbing effects of the electric lines in Bombay, but sufficiently near, presumably, to have similar magnetic conditions. The site was secured in 1902, and the construction of the buildings was completed in 1903. The Observatory was equipped with a full set of new magnetic instruments and comparative observations commenced in April, 1904. After securing an undisturbed duplicate record extending over a period of two years, the magnetic work at Colaba was stopped on 31st March 1906, fortunately before the electric tram service was completed and had commenced its operation. Dr. Moos published the two volumes entitled the 'Colaba Magnetic Data' which formed a comprehensive study of the continuous magnetic records obtained in the Colaba Observatory during the sixty years–1846 to 1905. Since 1919, the Office of the Director was filled up for short periods by Dr. C. W. B. Normand, Mr. T. K. Chinmayanandam, Dr. K. R. Ramanathan and Dr. B. N. Banerji, Dr. S. K.

Banerji, was Director for about ten years from 1922 to 1932 and the present Director is Dr. S. C. Roy.

A few years after the appointment of Mr. C. Chambers, as Director of the Observatory, the Government of Bombay created the post of Meteorological Reporter to the Government of Bombay, and located this officer, his staff and office at the Observatory. Mr. Frederic Chambers was appointed as the first Reporter and associated himself with Mr. C. Chambers in meteorological and magnetical investigations. In 1888 the post of the local meteorological reporter was reduced to a half-time appointment and placed under the control of the Imperial Meteorological Reporter. The local Superintendent of Telegraphs was appointed in this half-time post and his office transferred to the Telegraph buildings. This arrangement made in 1888 remained in force till April 1923 when the Office of the Meteorologist was again transferred to the Colaba Observatory. The half-time post of the Meteorologist was abolished and his office amalgamated with that of the Director, Bombay and Alibag Observatories, who was thereafter designated as 'Meteorologist, Bombay'.

The appliances and powers of the observatories at Colaba and Alibag are directed first to the prosecution of enquiries into the sciences of terrestrial magnetism, meteorology, and seismology; secondly, to the publication of recorded facts and observations, their reduction and discussion and to the distribution of such publications amongst the learned societies and men of science in all parts of the world; and thirdly, to astronomical observations for the purposes of time-keeping and to the signalling of time for the purposes of navigation. With these objects in view, the observatories are equipped with various magnetical meteorological, astronomical and seismological instruments installed in separate buildings, especially constructed for their accommodation.

The routine operations of the Observatory and the Meteorological Office consist in maintaining in continuous action the autographic instruments (magnetical, meteorological and seismographic); in taking eye observations five times a day of these instruments; in taking a regular series of observations for determining the absolute values of the various magnetic elements,

in reducing the data thus secured and in putting them into the proper form for publication and investigations; in publishing a daily weather report; in collecting data for marine Meteorology; in supplying weather and other reports to several officers and men of science, and in furnishing the requisite information on magnetical, meteorological, seismological and other allied questions to Government Officers and others. In the astronomical department the observations of the stars or the sun are made with sufficient frequency for the correct rating of tne large number of chronometers kept in store for issuing to ships belonging to the Royal Indian Marine and the Royal Navy and for directing the falls of the time-signal balls on the towers at the Castle and the Prince's Dock. Wireless time-signals from the various time transmitting stations, particularly Eiffel Tower and Nauen, are regularly received in the Observatory and compared with the local time.

The principal publications issued by the Observatory are:—

(1) Bombay Magnetical, Meteorological and Seismographic Observations, Forty-two Volumes.

(2) Meteorology of the Bombay Presidency.

(3) Colaba Magnetic Data, Two Volumes.

(4) Magnetic Disturbance Charts, 1905–1915.

(5) Rainfall in the Bombay Presidency, Six Volumes.

(6) Numerous papers published in the Proceedings of the Royal Society, Philosophical Transactions of Royal Society, Philosophical Magazine, Terrestrial Magnetism and Atmospheric Electricity, Nature and Departmental Memoirs and Scientific Notes.

The magnetic section of the Observatory is situated at *Alibag*, about nineteen miles south of Bombay. (For detailed description of this place and of the Observatory See special article.

S. C. Roy

THE MINT.

The first Mint for coining rupees and pies was established by Gerald Aungier in 1670, but the money was not accepted even at Surat " nor in any part of the Great Moghuls' domi-

nions or in any part of the territories of the Indian Kings; only it passed among the English in their fort and some two or three leagues up in the country, and in the villages along the coast ". The present building was designed by Major Hawkins R. E. and completed in 1829. The Assay Department and the office of the Mint Master are on the upper floor while the ground floor accommodates the Bullion Department.

The north end is occupied by the Silver and Nickel melting departments and the General Workshop, while the various coining departments are at the southern end.

The Mint machinery till recently was driven by steam engines, but these were replaced by electric motors, by which all the plant is now driven. Electric energy on the 3 phase A. C. system is supplied in bulk at high tension by the Bombay Electric Supply Co., to a transforming sub-station, in which it is transformed down to 400 volts; the current all at pressure is led to a main switchboard situated centrally in the Mint, and is led thence by feeder cables to the various groups of motors, each feeder being controlled by an oil switch; static condensers are used, close to the main switchboard, to improve the power factor of the installation; the motors are of the induction type.

The Mint has a normal capacity, working without overtime, of about 6 lakhs of rupees and 3 to 4 lakhs of small coin per diem. The amount of work, however, varies very greatly from time to time in accordance with the coinage requirements of the country. At the end of the war, there was a very large demand for Indian Government coin, and the Mint was therefore put on to working overtime and night work, namely, 20 hours a day; during this period the output was about 14 lakhs of rupees and 7 lakhs of cupro-nickel coins per day; the Calcutta Mint, which is a little larger than the Bombay Mint, was similarly required to coin as fast as possible: the approximate outputs of all coins for the years 1910–19 and 1919-23 by the two Mints were as follows :

		Bombay Mint	*Calcutta Mint*
1918–19	...	358 millions.	546 millions.
1919–20	...	275 millions.	310 millions.

These outputs are believed to be very considerably greater than have ever been achieved by any other Mint.

In addition to Indian Government coinage for which the Indian Mints are primarily intended, coinage for foreign Governments is sometimes undertaken, for instance, Straits Settlements, Ceylon and British Hongkong Dollars; coinage was also carried out for the Egyptian Government some years ago.

When the gold 15 rupee piece was introduced, this was coined in the Bombay Mint, but only a small quantity (about 2 million pieces) was done, as this coin was abolished shortly after. No gold coinage is carried out at present.

The processes of coining are roughly as follows:—(*i*) Alligating and binding the pots, *i. e.*, calculating and weighing in the proper proportions the metals to be melted together in each crucible so as to get the correct alloys for the various coins thus, rupees have 11 parts of silver to 1 of copper. (*ii*) Melting and pouring the metal into suitable bars. As there is a good deal of scrap left when cutting out the coin blanks, it is always necessary to melt a greater weight of metal than the weight of coin produced. For rupees the metal melted has to be about 50 per cent. more than the weight of coin produced. Thus for one lakh of rupees, the metal melted has to be about 1¼ tons. (*iii*) Rolling into straps. (*iv*) Cutting out blanks and edging. (*v*) Weighing blanks (*vi*) Annealing, (*vii*) Stamping, (*viii*) Examining, (*ix*) Packing.

At present no coinage is being carried out in Bombay, the total requirements being struck in the Calcutta Mint.

In 1927, a Silver Refinery was built and equipped in the Bombay Mint. This Refinery, which is the largest and the most up-to-date in the world, has been in operation since 1928, converting the surplus rupees, struck during the war of 1914–18 into fine silver and copper. It operates on the electrolytic principle, and Government fine silver is turned out at 999.0 fineness.

Owing to small quantities of gold recovered from the silver coinage and to the large quantity of silver refined, its operating costs compare very favourably with those of any other sliver refinery. The refining of silver for the public is also undertaken.

The rest of the work of the Bombay Mint consists of refining gold for the Kolar gold fields, and for the public, the melting and assay of gold and silver for the public, the manufacture of dies and medals for Government and public institutions, and the standardisation of weights and measures.

A. J. RANSFORD.

THE SIR J. J. SCHOOL OF ART.

This institution is under the Educational Department of the Government of Bombay and was established in 1857 in a temporary building. The present school for Drawing and Painting and Modelling, and for the Norm. ı Training Class for Drawing Teachers was built in 1878. The Reay Art Workshops were constructed in 1892 and the Sir George Clarke Technical Laboratory and Studios in which the Architectural School is accommodated were erected in 1907. This Architecturai School gives instruction up to the Final R. I. B. A. examination. The School of Art holds courses of study covering a period of; five years in Drawing and Painting, Modelling, Architecture and Design. The courses of study in Mural Decoration are attended by a selected number of students who have completed five years study in Drawing and Painting. Admission to the Normal Training Class for Drawing Teachers is granted on a competitive Examination to a limited number of students. The successful candidates at the Diploma Examinations of the various Sections of the School of Arts are allowed to affix to their names the designations G. D. (Art). G. D. (Arch), G. D. (Modelling) and A. M. as sanctioned by the Government of Bombay. In the Workshops instruction is given in Cabinet making. Wood and Stone Carving, Metal work, House Decoration etc, An Art Museum and an Art Library, are attached to the School and contain specimens of European and Indian Art and valuable books. The School of Art has its own Gymkhana Club.

W. E. GLADSTONE SOLOMON.

The School for the Blind, under the control of the American Marathi Mission, was established in 1900 at Dadar. The present number on the roll is 50, 25 boys and 25 girls. The ordinary school branches are taught along with music, cane-work and beadwork.

Victoria Memorial School for the Blind.—This school was established in memory of the late Queen Empress Victoria and is situated at Tardeo Road. It is both an asylum and a school. It opened on the 13th December 1902, under the Principalship of Dr. Nilkanthrai D. Chhatrapati, L. M. S., himself blind, who was invited to come down from Ahmedabad with his whole school of thirteen pupils. It has on its roll now sixty pupils. The institution teaches Gujarathi, Marathi and English Braille-reading and writing, besides arithmetic, geography, object and general lessons. Music, vocal and instrumental, tailoring, tape-weaving, bidee-making and cane and bamboo work form its chief industrial studies. It has an extensive compound, a well lighted and well ventilated commodious building with arrangement for drill and gymnastics. Every new pupil is, before admission, examined by the Ophthalmic Surgeon at the Sir C. J. Ophthalmic Hospital, and some have their vision restored. The school thus restores sight to such as can have it. The incurables are then put on the regular roll and educated to make themselves self-supporting, healthy and useful citizens.

The institution is aided by Government and the Bombay Municipality, besides other philanthropic bodies and individuals. Besides the buildings for the school and asylum and the quarters for the Principal, Manager, etc., the school has a fund of Rs. 1,75,900 wholly invested in Government securities in the names of the Trustees. There is a strong and representative committee of management.

The Bombay Institution for Deaf-Mutes, at Nesbit Road, Mazgaon, was founded by the late Bishop Meurin in 1885. Deaf-mutes of all creeds are admitted and instruction is given in articulation, lip-reading, arithmetic, grammar, geography, drawing and carpentry. Education is afforded gratis.

The David Sassoon Industrial and Reformatory Institution, is intended to reform juvenile offenders and to train them to habits of useful industry. Various useful subjects are taught including black-smithy, carpentry, carriage-building, painting, tailoring, brass-moulding, turning in wood and iron, spinning, weaving and gardening.

INDIAN COTTON COMMITTEE'S TECHNOLOGICAL LABORATORY.

The laboratories provide ample space, apparatus and special facilities for carrying out physical, botanical, physiological and agricultural investigations on cotton. The spinning laboratory contains various appliances for conducting spinning tests on different samples of cotton with a view to determine the bearing of the numerous measurable characters of cotton-fibre on spinning value. (For detailed description of the activities of these laboratories see separate note.)

MUNICIPAL NOTES

Arthur Crawford Market.—This market named after the then Municipal Commissioner was built in 1865 at a cost of over seven lakhs of rupees. It is situated at the end of the Fort District and is a complete block being surrounded by Hornby, Carnac, Palton and Crawford Market Roads. It is the largest of the 34 markets in Bombay. The main building is in the form of an L and in this portion fruit, flowers, vegetables, provisions and dry stores are sold. The other buildings, the sheep head and liver market, the refrigerator, the fish and mutton markets, the wholesale and retail beef markets, a two storied building, the lower floor comprising fowl rooms and the upper floor office rooms, the big building used as godowns, the two wholesale scale sheds for fruit and the Dubash buildings and pet stock market are built in the spacious compound. Practically every food article consumed in Bombay is stocked in the Crawford Market — from live game to ice. The whole market and compound is brilliantly lighted at night with high power electric lights. There are gardens in the compound and a big fountain designed by Lockwood Kipling when he was the Head of the School of Art, Bombay, is a feature.

C. M. FLANDERS.

DRAINAGE AND SEWERAGE.

The City has peculiar physical features. Its shape is saucer-like, with hollows in the centre and elevated land near the foreshore. The central part is below the high tide level. This peculiar configuration of the Island has played an important part in the evolution of the schemes for drainage and

sewerage. The final schemes adopted have not only been governed by these physical features but the vested interests of the public bodies interested in the welfare of the City, such as the Port Trust, the Improvement Trust and also the Government have been instrumental to a great extent in moulding the existing systems of drainage and sewerage.

The drainage of Bombay has been carried on the separate system i. e. there is one set of drains for the disposal of surface or storm water and another set of sewers for the disposal of sewage. Owing, however, to the existence of house-gullies in the central part of the City, a certain amount of storm water finds its way into the sewers during the monsoon. It would therefore be appropriate to say that the City is drained on a partially separate system. For the purpose of storm-water drainage, all lands lying above the high tide level are termed High Lands, and they are drained by storm-water drains discharging directly either into the open sea on the west or into the harbour on the east at different points. There are over 30 such outfalls into the sea. All lands lying below the level of the highest high water spring tides are termed Low Lands. The southern portion of these lands, i. e., upto Bellasis Road, is drained through the old main drain which runs from Bellasis Road to Love Grove, into which a number of covered storm-water drains from different parts of the southern low lands discharge. The central and the northern portions of the low lands discharge into the sea near the Worli Fort, through what are called Low Level Channels. Both the outlets at Love Grove and at Worli are provided with wooden sluice gates fixed into masonry, and these gates are opened during the ebb tide and closed at high tide in the rainy season. During the fair season, they are entirely closed.

From the above description, it will be seen that while there are few chances of flooding taking place in the high lands, the chances of flooding in the low lands are greater, especially when heavy down-pour of rain synchronises with high tide. The storm water drains are designed to carry a run-off of 1 inch per hour only. When the intensity of rain exceeds this limit, flooding of the low lands takes place for a short period even when the tide is low.

There are in all about 194 miles of storm water drains. their sizes varying from 9 inch circular pipes to 20ft. by 9ft. masonry drains. Many of these drains are old and are laid with flat gradients. As they cannot discharge freely at their outfall ends during the varying state of the tide, there is a tendency for the accumulation of silt in them. They are therefore required to be cleaned every year. A large amount of silt to the extent of 1,75,900 Cft. is removed per annum for a length of about 30 to 40 miles. The silt removed from the two Low Level Channels is about 4,78,300 Cft. per annum, while that removed from open main drains is about 4,61,000 Cft.

A scheme for improving the existing storm water drainage system has been sanctioned by the Corporation which provides for realigning, regrading and covering the existing main open channels and diverting a portion of the channel leading to Worli towards Love Grove. It also includes the construction of an impounding reservoir for collecting the storm water brought down by these channels and pumping the same therefrom into the sea. The cost of this scheme is estimated at Rs. 136 lakhs. Owing to the present acute financial stringency it will not be possible to undertake the works on this scheme in the near future.

SEWERAGE SYSTEM.

The portion of the Island from Colaba on the south as far as Elphinstone Road on the north is sewered and the sewage from these areas is conveyed by two main intercepting sewers, ovoid in section, one being 9 ft. by 6 ft. and the other 8 ft. by 5 ft. 4 ins. with a combined carrying capacity of 100,000,000, gallons per day, to Love Grove where after passing through screens and detritus tanks to arrest heavy mineral matter and floating materials, it is pumped into the sea through two outfall sewers 6 ft. in diameter extending about 2000ft. into the sea. A portion of the central area in the north viz. part of Dadar, Matunga and Sion is also sewered. The sewage from these areas is collected in a sump at a point between Dadar and Matunga. It is pumed from this sump into an open storm water drain running close by and leading to Mahim Creek. Before its discharge into the open storm water channel the sewage is chlorinated to keep it fresh for some time in order

to abate the nuisance due to smell in the vicinity of the pumping station. The only unsewered areas are Worli. Mahim, Dharavi, Gowari and part of Sion and Sewri.

Of the areas draining to Love Grove a major portion is sewered on the gravitation system. The feeders are all salt-glazed hardware pipes from 9 inches to 15 inches in diameter; 6 inch pipes are used for house connections only. All the sewers are provided with manholes of varying sizes and shapes covered over with heavy cast iron covers and provided with steps inside for the purposes of inspection and cleansing.

The sewage from the areas, which, owing to their configuration cannot be drained by gravity into the main sewers is lifted by means of Shone's ejectors and discharged through C. I. rising mains into the nearest gravitation sewers leading to Love Grove. There are 18 such ejector stations each containing two ejectors driven by compressed air supplied through underground air mains about 13 miles in length from three centrally situated air compressor stations.

There are more than 142 miles of pipe sewers and over 20 miles of ovoid sewers in the City. Almost all the main sewers are provided with catchpits at the inverts so as to intercept all sand, ashes and road detritus. These catchpits are cleansed periodically and about 98,900 Cft. of silt is removed from them annually. About 105 miles of pipe sewers are cleansed annually, the amount of silt removed being on an average about 76,000 Cft. in addition to about 18,300 Cft. of silt removed from the main sewers.

The pumping station at Love Grove contains 4 steam driven pumps, and four electrically driven pumps, of which two are old and two new ones. Normally, one new electrically-driven pump is worked pumping on an average 45 million gallons of sewage per day. At the time of peak loads both the electrical pumps are required. The quantity of sewage pumped as measured by the Venturi Meter recently installed amounts to about 55 to 60 million gallons per day in the dry weather. In the monsoon, in addition to the two new pumps, the two old electrically driven pumps are set to work. The wet weather flow amounts to about 75 to 80

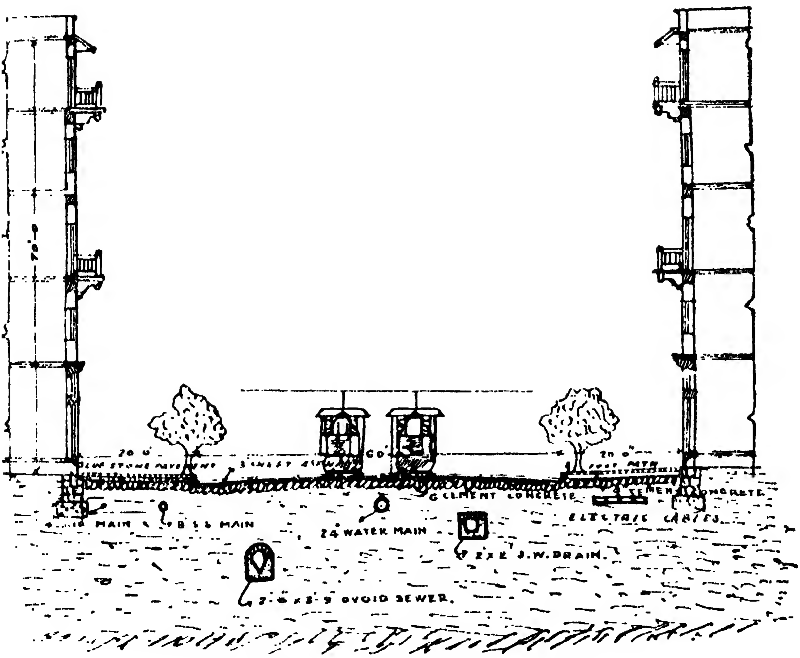
million gallons per day. It may be mentioned here that the total water consumption of the City has recently reached the figure of 90 million gallons per day. The consumption in the sewered areas may be taken as about 55 to 60 million gallons, The steam plant has been kept in reserve as a standby in case of the breakdown of electric pumps.

There has been a great controversy regarding the sewage outfall for the sewered and the unsewered areas of the City. After a good deal of discussion it has finally been decided to have three outfalls in the City, one at Colaba for the southern part of the island, to retain the existing outfall at Love Grove on the west for the central part of the city already sewered, and the third at Worli for the northern unsewered part of the City. Owing to the acute financial stringency it will not be possible for the Municipality to undertake the construction of new sewers to establish a separate outfall for the southern portion of the island. Similarly it will not be possible to undertake the Sewerage Scheme for draining the whole of the northern part of the island. It has however been decided to afford sewerage facilities to such of the developed areas in the north as are in need of immediate relief and also to remove the nuisance caused by the discharge of crude sewage after chlorination into the open channel between Dadar and Matunga, and for this purpose a sewerage scheme has been prepared and sanctioned by the Corporation. The cost of this scheme is estimated at Rs. 25 lakhs and it is believed that it would be completed in about 3 to 4 years' time.

N. V. MODAK.

ROADS.

It was in 1911, that the Sir Phirozshah Committee chalked the outline of the development of the roads in Bombay in order to facilitate movement of traffic in the city. The Committee's main recommendation was the construction of north-south arterial roads with east-west cross roads. It is gratifying to note that this objective has been achieved to a great extent due to the concerted action of the Municipality as well as other public bodies, and the Government. In 1911, there did not exist a single so called north-south road, but today the City possesses five main north-south roads such as (1) Hornby Vellard-Worli



Section of a typical Bombay road.

[Page 100

(2) Delisle Road–Lady Jamshedji Road (3) Palton Road–Victoria Gardens Road (4) Lamington Road and (5) Frere Road–Reay Road. There was only one east–west cross road viz. Carnac Road in 1911 but today there are six east–west roads such as (1) Mayo Road–Appollo Pier (2) Churchgate street (3) Napier Road–Sir Phirozshah Mehta Road (4) Marine Lines–Carnac Road (5) Sandhurst Road and (6) Savani Road–King Edward Road. The total mileage of city roads amounted to 161 in 1911 but today it stands at about 231. This shows that in the course of the last twenty years there has been an addition of over 70 miles to the city's roads. In 1911, almost all the roads in the City were water–bound macadam. The Municipality used to spend at that time about Rs. 6 lakhs per annum for their maintenance. The roads were without foundations and their treatment consisted mostly of 'patching' with an occasional renewal. With the introduction of the fast moving traffic it was found difficult to maintain the roads in good condition even with increased grants. In 1922–23 the cost of maintenance of roads reached the figure of Rs. 33.46 lakhs which was nearly five time that of 1911, though the total mileage of roads had increased by 27 only. The expenditure was being met from year to year from Revenue. In the year 1923, the Corporation accepted the scheme of financing the road expenditure from Capital funds. Owing to the adoption of this policy it has been possible not only to reduce the cost of maintenance but it has helped to remove the dust nuisance and provide comfortable travelling on the principal arterial roads of the City. The total intial expenditure on Capital roads uptodate amounts to about Rs. one crore. The permanent mode of construction of a particular road is fixed in accordance with the volume and nature of traffic to which it is subjected. The principal modes of construction for Capital Roads are (1) Sheet asphalt on cement concrete foundations, (2) Asphaltic concrete on cement concrete foundations, (3) Set stone pavement on cement concrete foundations, and (4) all cement concrete roads. The initial cost per sq. yard of constructing the four types of roads mentioned above amounted in 1921–22 to Rs. 23, 17/5, 12/5, and 10/6 respectively, while the current rates for the same types are only Rs. 11, 7/8, 6/4 and 8 respectively. Out of the

total mileage of 231 miles, 46 miles have been constructed on the above modes of construction from loan funds.

Coal tar was used in the beginning in the construction of water bound macadam roads, but its use had to be discontinued shortly after for several reasons. The water bound roads for the past ten years are being treated with natural or oil asphalts. There are about 129 miles of roads surface-dressed and about 11 miles of roads half or full grouted with asphalt. The mileage of roads treated with premix asphalt is about 48.

Out of the total mileage of 231 of roads in the City, there now remain 30 miles of water bound macadam roads, which will have to be improved in the near future.

The expenditure incurred in 1932-33 in maintaining all the roads in the City amounted to about Rs. 16.43 lakhs including interest and sinking fund charges on the loans raised, showing a saving of Rs. 17 lakhs on the cost incurred in 1922-23.

N. V. MODAK.

STREET LIGHTING.

Most of the Bombay streets are lighted either with gas or electricity. A few streets lying in the outskirts of the City in the north are lighted with incandescent oil lamps. All the lamps including columns, brackets etc. are the property of the Municipality. The Municipality does neither manufacture gas nor does it generate electricity required for street lighting but it has entered into an agreement with the Bombay Gas Company and the Bombay Electric Supply and Tramways Company for the supply of gas and electricity respectively. The gas mains and electric cables for feeding the lamps have been laid by the respective companies at their cost. Both the Companies are responsible not only for lighting and extinguishing the lamps at the scheduled times but they have also to repair, clean and maintain them in good condition. The payment for this service including the supply of the illuminant is made at a flat rate for each type of the lamp. There are several types of lamps in use. The work of lighting, extinguishing and maintaining the incandescent oil lamps including renewal or replacement of parts is entrusted to Messrs. Anderson Dawn & Co. A few

ordinary kerosene oil lamps are also in use for lighting unimportant passages. They are looked after by the Municipality.

There are at present 8673 street lamps in the City out of which 7083 are gas, 1420 electric, 150 incandescent oil and 20 ordinary kerosene oil. In addition, there are a number of lamps on the roads and wharves in charge of the Bombay Port Trust, for the maintenance of which an annual contribution is made by the Municipality to the Port Trust. The total candle power provided by the municipal lamps on the roads is about 21,50,000. Gas lamps contribute 16,55,000, electric lamps 4,05,000 and incandescent oil lamps 90,000. The gas manufactured by the Bombay Gas Campany is as per modern standard and has a calorific value of over 400 B. T. U. The quantity of gas consumed by the lamps per annum is roughly 20,04,25,000 Cft. The total aggregate load of electric lamps is 368.5 k. w. The electric units consumed per annum for street lighting amount to about 14,60,000. The total lighting hours per annum number 4054. The schedule of times is prepared in accordance with the hours of sunset and sunrise.

As regards the standard of illumination aimed at on certain important streets, it may be pointed out that the lamps provided at present are capable of giving a high standard of illumination but as most of them are not burning to their full power the avarage illumination in those streets works out between ·025 to ·04 foot candle, which compares favourably with that adopted in several European cities. The chief peculiarity of Bombay Street lighting is that along with main streets the side streets are also well lit. Though the City's lighting has been improved considerably in the past ten years, there is yet room for further improvement which cannot however be undertaken in the present state of Municipal finances. The improvements so far made consist of converting the old gas lanterns into those of the modern type and increasing their height from 9 or 10 ft. to 13 ft. 6 inches by the use of an extension piece in order to get better illumination. New lamps have been fixed at a height of 16 to 25 ft. above the road-level and they are spaced at intervals of 110 to 160 ft. In roads provided with roadside trees lamps are centrally suspended; on certain tram routes they are suspended between the kerb of the footpath and the outer rail of the tram

line. In other roads, they are arranged either in a staggering fashion or on one side of the road only. The latter method is used in exceptional cases where it is not feasible to resort to staggering. Refuge islands have been used for the erection of lamps in roads subjected to fast and heavy vehicular traffic.

The total number of lamps in 1928–29 was 8320 which has increased to 8673 in 1933–34. The cost of maintenance amounted to Rs. 10,99,738 in 1928–29 while the budgetted provision for the year 1933–34 has been reduced to Rs. 10,19,118.

[For information regarding water supply, see special article at the end.]

N. V. MODAK.

I. M. M. T. S. " DUFFERIN."

The Indian Mercantile Marine Training Ship " Dufferin " began her service as a Training Ship in November 1927. In each year, thirty-three candidates from among British Indian Subjects or Subjects of a Ruling Indian Prince are selected by examination and interview, to be trained to become good and efficient Officers in the Merchant Navy.

The Staff of the Ship consists of certificated Merchant Navy Officers and qualified Schoolmasters, together with Petty Officers who have had many years experience of the Sea. Every Cadet is expected to reach an educational standard, which will enable him to pass the necessary Government Examinations for Second Mate, Mate, and Master; and in addition to reach the Matriculation standard in general subjects; The Syndicates of several Indian Universities recognize the " Dufferin " Final Examination as equivalent to their Matriculation Examination, whilst others grant the same recognition under certain conditions.

Particular attention is paid to character training. Throughout their course, the Cadets are taught to think for themselves, to cultivate initiative, to develop their powers of observation and to shoulder responsibility. Cadets in their third and last year are all given some special duty in which these qualities are especially necessary. They are taught to realize that there is no indignity in actual manual labour, while, on the other hand, they receive a social training, which will enable them to move

in any society without embarrassment. ,Very strict discipline is maintained and many of the comforts and amenities of a life on shore are foregone, as an integral part of a training for the arduous and trying life of a sailor. The Cadets belong to a wide variety of castes and creeds, but they live, work and play together in perfect harmony. There are excellent facilities for games, football, hockey and tennis being played, for which a field of three acres is provided.

After completing a three years' course of training on the " Dufferin ", Cadets go to Sea as apprentices for a further period of three years, after which they are permitted to sit for the examination for Second Mate. Nearly all the British Shipping companies trading with India have agreed to accept the "Dufferin" Cadets as apprentices.

Of the first batch of " Dufferin " Cadets who have completed their apprenticesdip, twenty have sat for the Second Mate's Examination and seventeen have passed, seven of whom have been selected for the Bengal Pilot Service, and all the rest are now serving as Officers.

There are in addition five Cadets in course of training to join the commissioned ranks of the Royal Indian Marine; five are in the River Hughli Survey; seventy-three are serving their apprenticeship at Sea. With the exception of two or three, actually all those Cadets who completed their course in the " Dufferin " up-to-date have had some suitable opening offered.

The Government of India do not guarantee posts or facilities for proceeding to sea from the " Dufferin ", but the number of entries is limited to opportunities for proceeding to sea, and employment as Officers in due course is available, for the majority who are trained.

H. A. B. DIGBY-BESTE.

N. POWELL AND COMPANY, LTD.

Nearly half a century ago the foundation of this business was laid by Dr. A. L. Nair. The beginning was very humble and nobody could have at that time prophesied that the small shop which had few drugs and patents in stock would develop into a big firm after a few years. A small workshop for repairing surgical instruments and manufacturing Orthopae-

-dic Appliances and Artificial Limbs was opened in the year 1899. At the same time a small Laboratory for preparing Pharmaceutical Preparations, such as Tinctures etc, was also established. By dint of efficient work, this firm won the confidence of their constituents and within a couple of years, the small workshop grew into a factory. The business began to expand so rapidly that the old place at Duncan Road was found insufficient and therefore in the year 1913, they had to erect a new building at the junction of Lamington and Sandhurst Roads. At present their Offices and Selling Departments are located in this building. After a few years they had to shift the factory from the old place. In the year 1918, they bought another extensive plot near Club Road and built separate buildings for Surgical Works and Pharmaceutical Works. Even these new buildings were found inadequate for their ever increasing volume of business and therefore, a huge new building for locating both the Pharmaceutical and Surgical Works was erected in the year 1924.

The Works of this concern are fully equipped with the latest plant and machinery, and now they manufacture most of the Surgical Instruments from start to finish. In the beginning, this firm had to encounter several difficulties in manufacturing their products. In a place like India where industry is in such a backward state, the pioneers of an industry have to depend upon themselves for the various things required in the construction of their articles. In Europe, it is absolutely different as it is very easy to get a particular part which is not made by that firm from their next door friends. With perseverence and hard work, this firm soon won its way to leadership. During the Great War, N. Powell & Co. rendered valuable services to Government and they equipped several War Hospitals, Hospital Ships etc. They have their own Printing Press. The products of this firm are of very high quality and they were awarded the much-coveted " Grand Prix " in the World Exhibition held at Paris in the year 1900 for the superior workmanship of their instruments. A visit to their Works is very interesting. One can see there Surgical Instruments, Veterinary Instruments, Dental Instruments, Aseptic Hospital Furniture, Orthopaedic

Appliances, Artificial Limbs, Trusses, Belts, being manufactured from start to finish.

The manufacture of orthopaedic appliances is a special feature of this firm.

Orthopaedic is the science which teaches the different methods of preventing and correcting the deformities of children and adults. It is needless to explain here how very useful this industry is for the suffering humanity. It has been found out by experience that deformities in children could be satisfactorily rectified if prompt treatment is given under proper advice. It is the neglect and the ignorance on the part of parents that usually renders the whole life of the children useless. In Europe there are several institutions and highly qualified specialists in Orthopaedics and as the public there are well educated, they take proper precautions as soon as they find any defect in their children. In India, the case is entirely different. Not only are there very few places where one could get proper advice, but the people also have not still learnt to realise the great advantages of rendering immediate treatment to their deformed children. This because they are ignorant of its possible effect upon their children when they grow up. It is therefore necessary for the medical practitioners to give proper advice to their patients when they see such cases and direct them to a proper place.

Till the year 1899, there was no one in India who could supply Deformity Appliances. N. Powell & Co. of Bombay by taking up this important industry in their hands have contributed more than anyone else towards the amelioration of the suffering humanity. They have now more than 34 years' experience in manufacturing Artificial Limbs and Orthopaedic Appliances and in their factory which is the largest of its kind in this line in India, they are able to manufacture every kind of Orthopaedic Appliances on scientific principles. They have highly trained experts of long experience to construct fitting appliances. One thing must be remembered that an appliance or artificial limb prepared by inexperienced people and which is not scientifically manufactured is not only useless to the patient but it is likely to aggravate his sufferings also. Appliances for

Spinal Curvature, Flat Foot, Talipus Equinus and Varus, Wry Neck, Knock-Knee and Bow-Legs, are all made by N. Powell & Co., Ltd. They also specialise in manufacturing Artificial Limbs, Abdominal Belts for Obesity etc. and Trusses for Hernia. They have an Electrical Department where X-Ray Skiagrams are taken for deformities and they also give electrical treatment to such cases.

M. VENKATRAO.

BOMBAY MARINE FISHERIES.

The Government of Bombay have taken early measures to implement some of the recommendations made by Mr. H. T. Sorley, I. C. S., in his report which was published early this year on the marine fisheries of the Bombay Presidency. As a first step in developing the marine fisheries the Government have set up a fisheries section under the Director of Industries with the object of organising on a scientific basis the City's fishing industry.

The inadequacy of the supply of fish in the Presidency has been emphasised by Mr. Sorley who recommended the use of power-propelled boats as is done in Japan, with the object of augmenting the present amount of fish available for marketing.

Government have accordingly launched on the experiment in order to ascertain the benefit which will accrue to the City's fishing industry by the provision of motor launches for the transport of fish from the fishing grounds to the City's markets.

As is well known, the only way of transport hitherto employed, to bring to the shore the fish from the place where they are caught, has been to use ordinary sailing craft. Such craft often finds it difficult, owing to weather conditions, to make for the bunders directly they are loaded up with the catches, miles from the shore. Quantities of fish arriving in Bombay have, therefore, to be often destroyed as unfit for consumption.

It is felt that the fishing industry is capable of considerable improvement in various directions and as a first step in demostrating the possibilities Government have provided a motor launch borrowed from the Royal Indian Marine to help the local fishermen.

The launch is being used as a collecting vessel, in order to bring fish to the market in good condition and to enable the actual fishing boats to remain at sea continually for a longer period.

On the basis of the experience gained, as a result of the operation of this launch, the Department of Industries will provide two launches for the construction of which Government sanction has already been obtained. These launches will be equipped with Diesel engines using crude oil.

Incidentally it may be noted that the Department of Industries has already examined the possibility from the engineering point of view, of converting the ordinary sail-boats in vessels capable of propulsion by Diesel engines. Expert opinion obtained on this subject by the Department shows that fishermen need not necessarily embark on the expense of acquiring new boats for their requirements, if they decide to use mechanically propelled boats for their collecting and transporting fish. That their ordinary sailing craft are capable of convertion is demonstrated by the experiment of the Burmah Shell Oil Company, which has successfully installed a 10 H. P. Diesel engine on an ordinary fishing boat measuring 24 feet in length. This boat has been given several trials, all of which have been satisfatory. This problem of converting sailing craft into power-propelled boats therefore seems to be capable of successful solution.

Youths belonging to the fishing community are being trained in the running and maintenance of motor launches, the object being that eventually they may be able to take charge of their own launches, when it has been proved to their satisfaction that such conversion is beneficial.

Simultaneously, the Department of Industries is examining the possibility of improving and expanding the arrangements for the marketing and preservation of fish, the provision of better facilities for its transport by rail, and any other improvements by which the fishery industry can be best assisted.

Lastly a fishery information bureau is also being organised. The function of such a bureau will be to collate and supply information connected with the local and other fisheries. The data and statistics collected by the Bureau will be directly use-

ful to the fishing industry as it will furnish information not now available to the people concerned.

S. B. SETNA.

ANTI-MALARIAL MEASURES IN BOMBAY.

Anopheles stephensi is the malaria carrying mosquito in Bombay. All water containers to which this mosquito is likely to gain access must therefore be protected against its entry. It has been observed that this mosquito prefers to lay its eggs in water which is replenished, and besides, it is a clean water breeder. All domestic water cisterns and every other collection of clean water are potential breeding places of this mosquito. Antimalarial measures must therefore be concentrated on the control and eradication of this mosquito.

The following measures are adopted for the *Anopheles stephensi* in particular and mosquitoes in general :—

(1) *Domestic Cisterns.*—Most of the houses have water storage cisterns for domestic use and for flushing water-closets. If any such cistern is in a non-mosquito-proof condition *Anopheles stephensi* has been invariably found to breed in it. These cisterns must therefore be considered to be dangerous potential sources of breeding and must therefore be guarded against the mosquito. Mosquito-proof-cisterns have specially been devised from this point of view.

A cistern is made of wrought iron plates and all its sides are firmly secured by means of rivets. It has an opening in the top sheet known as the man-hole. A cast iron rim with a collar is fixed on this man-hole which is provided with an iron cover cast in one piece. This cover is fixed on to the man-hole rim by means of a hinge and a hasp. The bar across the top of the lid should be short so that both the hinge and the hasp are as close to the lid as possible. This is done to ensure proper closing of the lid and putting on a lock. The other standard parts of a cistern are a feeding pipe, an overflow or warning pipe. The feeding pipe is fixed in one of the side sheets and at its junction with the sheet a checknut is provided with a view to leave no chink around the pipe. The same precaution is observed as regards the outlet or overflow pipes. The overflow pipe is provided at its loose end with a standard pattern cap to

protect it against the entry of a mosquito in the cistern through the pipe. This protector consists of a brass ferrule provided with a brass plate having perforations not bigger than $\frac{1}{16}$th of an inch in size. It can be easily fixed to the end of the pipe.

The lid of every cistern is required to be kept under lock and key and any unnecessary interference with this arrangement is dealt with under the law.

Each cistern is numbered in a serial order so that there may not be any possibility of omitting to inspect any cistern during the weekly routine inspections. To facilitate easy and quick inspection of domestic cisterns provision of easy and safe means of access is also made compulsory. It is insisted that an iron ladder should be fixed permanently for every cistern so as to make it easily accessible, where no other safe means of access exist.

There are 38,379 cisterns in Bombay. The work of the Malaria Department is so organised that every cistern must be examined as regards its mosquito proof condition once a week regularly as a matter of routine. If any defects are noticed, steps are taken immediately to put it in proper order by issuing statutory notices requiring the work to be done within a week's time.

(2) *Wells*—In ancient times wells formed one of the important sources of drinking water supply in many Indian cities. But with the improved means of public water supply they have outlived their utility and from the point of their being favourable potential breeding places of mosquitoes are a menace to public health from the malarial point of view. Bombay may be quoted as a striking example of this. With sufficient public water supply, private wells are hardly needed for the usual domestic requirements of any individual. Wells have been found to be very favourable sources for the *Anopheles stephensi* to breed particularly in the southern parts of the city. It has been conspicuously absent in the northern part although *Anopheles subpictus* (*rossi*) and *culex* are abundantly found breeding in wells in this area.

After the first malaria survey was made in Bombay in 1908 it was recommended that wells should be covered with cement

concrete leaving an opening fitted with wire gauze trap doors. The object of the wire gauze was to prevent the entry of mosquitoes in the wells. But time has shown that these trap doors have not served any useful purpose as regards mosquito control since they are always found left open. Concessions for trap doors were granted in those days on account of religious objections to pipe water. A trap door even if kept closed after use would hardly maintain the arrangement in mosquito proof condition which was the main object of providing them. Having been made of wooden frames fixed on hinges they soon became loose or broke and rendered the well non-mosquito proof. In the majority of cases these doors would be intentionally left open during night by some people holding peculiar superstitious views.

To guard against all these abuses stricter measures have been adopted since the last malaria enquiry which was held in 1928. It was recommended that wells should either be filled in or hermetically covered with cement concrete. No trap doors should be allowed in any case.

As one of the most important anti-malarial measures closure or filling of wells would be a boon to the City but to meet with the requirements of certain religious minded section of people, a policy has been adopted to eliminate their number as largely as possible. According to this policy all wells situated in temples or other places of prayer or worship such as Hindu Temples, Parsi Agiaries or Fire Temples and Mahomedan Mosques or Masjids, and in public charitable institutions known as Dharamshalas are to be retained open for the use of the public who need well water. Over and above these a few private wells are also to be kept open for the same purpose. In the selection of private wells for being kept open it is stipulated that at least one well will be kept open within a distance of 500 yards. With the exception of such wells and those which will have to be retained in the northern part of the island for the watering of palm trees all other wells in the City have either to be filled with earth or covered with cement concrete.

It is cheaper to cover a well than filling it and the majority of the owners prefer to do so as in case of emergency the cover can be broken open and reconstructed. If in spite of covering, well water is required to be drawn the Malaria Department does not

object to the installation of a hand or mechanically worked pump, provided the mosquito proof condition is not disturbed.

There are newly devised hand pumps now on the market in which no leather or rubber parts are used and which find ready sale among people who object to the use of these materials in any devise used for drawing water for religious purposes.

Certain section of the public objects to the cement concrete cover as no light and air can pass in the wells although they have been permitted to instal pumps for drawing water. To meet with their requirements they are allowed to fix thick glasses about 1 inch in thickness and copper plates with perforations not bigger than 1/16th of an inch, in the cement concrete for the entry of light and air respectively. This arrangement has found favour with some people as it provides them with all which their sentiments demand and at the same time meets with all the requirements of the Malaria Department.

Mosquito breeding has to be controlled in wells which are kept open in the City for purposes mentioned above. Oiling cannot be employed as water is to be used for drinking purposes and clean water is needed for the performance of religious ceremonies. Whatever measure adopted for mosquito control must therefore be such as to maintain water suitable for these requirements. This is achieved by the effective action of certain fish on mosquito larvae. Water of wells stocked with larvicidal fish remains clean and free from mosquito larvae. In Bombay the fish ordinarily used for this purpose belongs to the species *Anabas scandens* and is known locally as Khajura. It has been ascertained that one dozen of these fishes are enough for 15 square feet of water surface to produce effective larvicidal results. It is however necessary to observe the results by periodically examining the water for larvae. As a rule wells stocked with larvicidal fish remain free from mosquito larvae but if in spite of the presence of fish, breeding is found to take place, steps are taken to destroy it by dusting the water with Paris Green mixture. The combined action of fish and Paris Green has been found to be very effective for mosquito control in wells but it is needed only for wells in which there is some vegetation which protects the larvae from the fish. In wells

free from vegetable growth fish alone is sufficient effective and the combined measure hardly becomes necessary.

(3) *Permanent Breeding Places in Gardens and Compounds*:— These are fountains, underground masonry tanks or tubs and barrels used for storing water. If these are not scrupulously looked after regularly from anti-mosquito point of view, they become very fruitful sources of mosquito nuisance and consequent malaria danger.

The residences of most of the wealthy class of people have gardens attached to them. Ornamental fountains are to be found in most of these gardens. These fountains are so constructed that they have big circular masonry tanks at the bottom and above in the centre there may be several other basins either of stone or metal. Water spraying from the fountain drops and collects in these basins and the tanks. Fountains thus become potential breeding places. Breeding cannot be checked by oiling the water as it will spoil the fountain and the owners will not allow the water to be spoilt by oiling as the water collected in the fountain tanks is invariably used for watering the garden plants.

For controlling mosquitoes in these fountains it is therefore enjoined that the basins should be either filled with cement to disallow collection of water in them or provided with holes to drain away water. Similarly the bottom of the tank is required to be so sloped and drained that it can be completely emptied. Fountains have been allowed to remain on condition that they will be completely emptied once every week and kept dry for at least 24 hours, preferably on the day of the Malaria Overseer's weekly inspection of the place. The ideal method of watering plants would be by means of a hose pipe which could be attached to a water stand post. But owing to the antiquated methods of the gardeners and the tendency of owners to economise on water charges by utilising the water from the fountains for watering plants the suggestion for using hose pipe has not received much response. Where there are no fountain tanks for storing water, masonry tanks specially constructed for the purpose have been provided, and in some cases big wooden tubs are used. These prove to be very common breeding places in gardens if precautions are not observed for efficient control of

mosquito breeding. These are filled with water every day and water is pailed out by the gardener for watering: some water is however bound to be left in these. As an anti-mosquito measure it is made obligatory on the owners to connect such masonry tanks to drains on their premises and they are required to empty and keep them dry for at least 24 hours once every week on the day of the Malaria Overseer's visit. The wooden tubs have also to be emptied at least once a week or at more frequent intervals if necessary.

These precautionary measures for mosquito control are usually applicable both for private and public gardens, but in the Victoria Gardens which is a botanical and zoological garden in Bombay certain intricacies in the anti-mosquito measures have to be faced with. There are big artificial puddles in which valuable water birds are kept. *Anopheles* mosquitoes are invariably found breeding in these and sometimes when *Anopheles* breeding is checked *culex* begin to breed. Bearing in mind the presence of birds in these puddles very careful measures have to be devised. Oiling is out of question although it would destroy both culex and Anopheline larvae, as it would be injurious to the birds. Fish can be of no help as the birds will not let the fish live.

Anopheline mosquito control in these puddles has been successfully effected by the use of Paris Green. Water is dusted with Paris Green mixture by means of a mechanical blower regularly every week and there has not been any poisonous effect on the birds. The regular periodical treatment with Paris Green of these puddles has amply substantiated the prevailing view regarding the non-poisonous effect of this arsenical compound on birds.

(4) *Water-closet flush cisterns.*—There are two types of flush cisterns, (1) the automatic flushing tank which is usually installed for public latrines or urinals and (2) the pull chain flush tanks for private water-closets.

The automatic flushing tanks are made of galvanised tin sheets provided with lids of the same material. The tank is an oblong box and it has been found difficult to keep it in mosquito proof condition as the lid does not fit tightly and very

often the cisterns are tampered with and the lids are not replaced carefully. This type has now been condemned. Mosquito-proof cast iron automatic flush tanks are now available in the market and whenever the old patterned cisterns are found non-mosquito proof they are required to be replaced with the new type. As long as the automatic contrivance works and water from the tank is discharged every now and then, so long there is no possibility of mosquitoes breeding in them. But the danger arises when the flush is out of order. The Malaria staff is required to treat with Saponified Cresol water in tanks which are found out of order.

The water-closet flushing tanks which have so far been installed in Bombay have not been of mosquito-proof pattern. The cover of such a cistern is not tight fitting, and besides there is an open slit in the cover for working the flush. In occupied buildings there is no risk of mosquitoes breeding in the water closet flushing tanks as the flushes are constantly in use, unless they happen to be out of order. But in unoccupied buildings there is always a possibility of mosquito breeding in these tanks and also in the water seal of the water–closet pan. Regular inspection of such buildings for seeing the water–closets also forms part of the routine work of the Malaria staff. At each inspection the water-closet is flushed or if the flush is not found in working order a little Saponified Cresol is added to the water in the tank and in the pan.

The use of these non-mosquito-proof flushing tanks has recently been discontinued and for any new building no such tank is allowed to be installed. Mosquito-proof flushing tanks which have tight fitting cast iron covers without any holes or slits are now obtainable. The installation of such flushes has now been made compulsory for all new buildings.

(5) *Roof gutters and terraces.*—Some of these are likely to become temporary sources of mosquito breeding during monsoon and therefore all roof gutters and house terraces have to be carefully inspected for any water collections. Water may collect and remain stagnant in roof gutters due to improper slope of the gutter towards its outlet or due to any obstruction. Some of the house terraces hold rain water in depressions or places which not properly sloped towards the outlet. Mosquitoes are found

breeding in these water collections if they are allowed to remain for a week or so. When such water collections are noticed, it is the duty of the Malaria staff to get the water swept off and subsequently to require the owner to take such steps to remedy the defects as to prevent water accumulating anywhere on the terrace.

(6) *Overhead Sprinkler Tanks in Mills.*—These tanks are installed in mills at heights not less than 100 feet. Even at this height *Anopheles stephensi* has been found breeding. As an anti-mosquito measure, therefore, these tanks are required to be covered hermetically either with wrought iron plates or cement concrete. Manhole openings are allowed but they are required to be provided with the standard pattern cast iron covers similar to those provided for domestic cisterns. One additional fitting is required for these tanks which is the water level indicator. Different kinds of such indicators have been devised but the one ordinarily in use and which has been approved consists of a float on the water surface which is connected by means of a wire to a lead or iron ball. The wire passes through a hole in the cover of the tank and its other end with the ball passes over a pulley and hangs on a side of the tank. On this side the figures indicating the depth of water in the tank are painted and as the float on the water surface inside the tank rises or falls the ball outside indicates the water level. The hole through which the wire passes is required to be made just enough for the wire to play. If the hole is made in the cement concrete it is likely to become bigger in course of time rendering the arrangement non-mosquito-proof. To obviate this a small iron plate with a hole through which the wire is passed, is fixed in the concrete cover. In the case of wrought iron covers the hole can be made in one of the plates. In connection with these holes made in the covers for water–gauges it is necessary to see that there is no gap or chink surrounding the wire more than 1/16th of an inch.

The same conditions as in the case of domestic cisterns apply to these tanks for maintaining them in a perfectly mosquito proof condition. They are required to be examined periodically.

(7) *Mill ponds.*—The other potential breeding places in the mill are the mill ponds. These are invariably found breeding

mosquitoes. In most of these culex mosquitoes breed profusely but it is not unusual to find Anophelines breeding in some of the tanks. In dealing with these potential breeding places in Bombay it is more a mosquito problem than a malaria one. as the malaria carrier Anopheles stephensi has very rarely been found breeding in these ponds.

Oiling is resorted to as an anti-mosquito measure for these tanks. Every tank is oiled once every week either by the Malaria Department staff or by the mill authorities themselves. In cases where the mills have joined the oiling scheme of the department they are made to pay a certain sum every month.

There may be some technical objections for oiling the water or for using any chemical in such tanks; as for instance there has been in one case in Bombay. This is a dyeing mill and the water in the tanks is taken from the Municipal supply. The water is replenished every now and then with the result that the clean water breeds Anopheles-fortunately the non-malaria carrier, Anopheles subpictus. As no oil or chemical can be used larvicidal fish have been stocked in the tank to control mosquito breeding, care being taken to see that there is no vegetable growth which would impede the effectiveness of the fish.

(8) *Fire buckets.*-According to the fire insurance rules buckets are required to be kept full with water. If this water is changed every day there would be no risk from mosquito point of view; but as this is not always done, these water buckets are often been found breeding mosquitoes. As a precautionary measure the mill authorities are required to keep this water treated with Saponified Cresol. This disinfectant imparts a milky colour to the water and makes it easy for the inspecting staff to see whether the necessary precautions are being taken.

Sand has been recommended as a substitute for water in these buckets for extinguishing fire but it has not met with the approval of the insurance agencies.

(9) *Machinery and scrap iron.*—Machinery parts of various kinds, barrels, tubs and scrap iron of any conceivable kind are found stacked in many mill compounds. These are a menace to public health during monsoon as they hold rain water and constitute temporary breeding places for mosquitoes. As a precau-

tionary measure the mill managements are called upon before the rains set in either to remove or to keep all such articles in covered places so as to prevent collections of rain water in them. If in spite of this any articles are found holding water, care is taken either to remove the water or to oil the water every week regularly.

(10) *Building works.*—During the construction of a building, big or small, several breeding places are temporarily formed. If the work is started during the rainy season water accumulates in the foundation trenches, or subsoil water may collect in them in dry season. They become breeding sources until they are again filled up. A mortar mill or chunam ghani is an indispensable accompaniment of big construction works. It is also likely to be one of the breeding sources if water is allowed to collect in the circular trench in which the mortar is pounded. There are masonry tanks specially built for storing water and all kinds of wooden tubs and barrels are also used for various purposes. The commonest use made of these receptacles is for soaking bricks in water before they are used for building.

Cement concrete buildings have in recent years become more popular and are being built on a large scale. In the construction of the floors of these building it is necessary to store water on the concrete surface by impounding it with small bunds for the purpcse of setting the material. This water is kept stagnant for several days and replenished daily with fresh water. In the absence of any precautionery measures *Anopheles stephensi* has been invariably found breeding in these water collections.

The procedure followed in the road construction works for consolidating the concrete layer is the same as above and mosquitoes of the same variety have not infrequently been found breeding in the water stored for setting.

No sooner a building construction work is started than the Inspector of the Ward is required to submit a detailed report to the Officer in charge of the anti-malarial operations. The attention of the owner or building contractor is then drawn to the various breeding sources which may exist or are likely to be created during the progress of the building works and he is called upon to take steps for the prevention of mosquito

breeding by completely emptying all water containers at the end of the day's work and for such other collections of water as are made for setting cement the use of Saponified Cresol is insisted upon. If mosquito nuisance arises on failing to comply with the suggested measures legal action is taken to enforce the requisite preventive measure.

(11) *Cellars.*—Many newly constructed buildings on Ballard Estates and some old buildings in the town which are occupied by commercial firms have been provided with cellars. Subsoil water percolating into these cellars constitutes mosquito nuisance. The owners are required to render these water-tights by means of impermeable material. Some of the cellars have thus been made water proof during recent years and no water has been found to percolate through the material which has been used for the purpose.

The water in cellars which have not been thus made impervious is required to be treated with Saponified Cresol once every week regularly to prevent mosquito breeding. All cellars which have not been made water tight have to be inspected by the Malaria staff once every week.

(12) *Seepages from water reservoirs.*—There are two Municipal water reservoirs in Bombay, one at Malabar Hill and the other at Mazagaon known as Bhandarwada reservoir. Seepage water percolating through the sides of the reservoir, if allowed to remain stagnant in any hollows or depressions forms very suitable sources of mosquito breeding. Anopheles stephensi has been found breeding in such seepages. Hollows and depressions in which the water collects may be filled in with earth or the breeding may be destroyed by oiling. It has been found that the best way of dealing with the seepage is to drain away the water. For efficiently draining all the seepages it is necessary to divert them into several small properly cemented channels which could be connected to a bigger one discharging into a storm water drain. Weekly attendance to these seepages from the reservoirs forms part of the anti-malaria crusade work.

(13) *Temporary breeding places.*—The work of the Malaria Department enormously increases during monsoon due to the formation of any amount of temporary breeding places. The

most common temporary sources of breeding which call for careful attention of the Malaria Department may be stated here.

(a) *Machinery and scrap iorn in Railway yards.*—All kinds of heavy or light machinery, scrap iron and receptacles of various description are found stored in Railway yards. During the rainy season most of these articles hold water and constitute a source of mosquito nuisance. On the weekly visit of the Malaria staff to these yards steps are taken to empty such receptacles or articles as could be easily overturned. The collections of water in the heavy articles are oiled to prevent or destroy breeding if found.

(b) *Private stores.*—There are a number of dealers in the City who trade in all sorts of empty drums, barrels and tins. These stores if allowed to remain in the disorderly manner in which they are ordinarily kept would become very serious sources of mosquito nuisance due to the collection of rain water in the various receptacles. With a view to prevent this the owners of such stores are served with notices, sometime before the onset of rains, either to remove all the receptacles or to keep them in covered places in such a way as to disallow any collection of water. It is not possible in some of the cases to remove these articles but the receptacles are protected from rain by erecting temporary sheds.

(c) *Municipal Road Department stores and other public stores.*-In several parts of the city there are Municipal Road stores. In these stores a large number of barrels containing coal tar used in road construction and empty barrels are stored. It is generally insisted that all the empty barrels should be kept overturned to prevent collection of rain water but in spite of this measure there is still a risk of water collecting in a small space at the bottom which is formed by the circular rim of the barrel. To avoid water collection in this, it is required to be filled with sand which is available in the stores. The barrels which are full are also likely to be sources of mosquito breeding on account of the same reason and they are therefore required to be kept on their sides. If any water collects, in spite of these precautions and becomes a source of mosquito breeding, the overseer in his weekly crusade destroys the larvae by oiling the water.

16

The other public stores contain barrels, tubs, drums and tins The same precautions as above have to be observed in the case of these stores.

(d) *Odd receptacles in private premises.*—It is not uncommon to find several kinds of disused articles being thrown about in the vicinity of dwellings. These by holding water are likely to afford good breeding material for mosquitoes. During the routine mosquito crusade work the malaria staff has to see for odd receptacles in every place they visit. If the articles are such as could be easily handled by them, they are overturned so as to prevent collection of rain water. If the receptacles are of no value they are collected and removed. If however they are big the owners are called upon to remove them or to place them in such a way as to disallow water collections.

(e) *Depressions and low-lying lands.*—These become sources of mosquito breeding during monsoon when rain water collects and remains stagnant sufficiently long for mosquitoes to breed. The variety of breeding in these differs. In some small temporary depressions in the southern part of the City, *Anopheles stephensi* is found breeding whereas in most of the low-lying lands which remain under water during the whole of the monsoon in the northern part, the species found breeding is invariably *Anopheles subpictus.*

Whenever mosquito breeding is detected during the routine crusade work steps are taken immediately to destroy the larvae by oiling. The owners of lands where such depressions are found are called upon to fill in the depressions with good earth so as to prevent any accumulation of water.

As regards the low-lying lands in the northern part of the City which remain under water and some of which are used for grass cultivation, measures are adopted for mosquito control by the use of Paris Green. During the rainy season these are regularly sprayed with Paris Green mixture once every week. At the end of the monsoon whatever water remains is pumped out into neighbouring storm water drains.

Organisation and work of Malaria department–For Municipal administration Bombay has been divided into seven wards. For

antimalarial work staff is engaged according to the requirements of each of these wards.

At the head of the department there is a Malaria Officer who is responsible to the Executive Health Officer for all anti-malaria work. The supervising and inspecting staff of the department consists of eight qualified Malaria Inspectors, eighty overseers, seven Mukadams, two hundred coolies, a mason and a carpenter. The Malaria Inspectors possess a registerable medical qualification and some of them have been trained in Malaria work. There is one Inspector in charge of each ward and an additional one who looks after anti-malarial work in mills in the northern part of the Island. The Inspectors have their offices in their respective wards. Each Inspector has under him a certain number of overseers and each overseer is given two coolies. The number of overseers varies in different wards according to the extent of the ward and the nature of the work.

The duty of the Malaria Inspector is to supervise the work of the overseer and to control the whole staff under him. He is required to attend to all the mosquito complaints and to report on all matters relating to mosquito control and prevention of Malaria in his ward.

For the work of the overseers each ward has been divided into several sections and one overseer is placed in charge of each section. These sections are again sub-divided into six blocks each. An overseer is required to inspect all water containers and other potential breeding places in each of these blocks on an appointed day in a week. In this way he is able to attend to all water containers and other potential breeding places in his section during the course of a week. Each overseer has to maintain a mosquito record book. In this book a careful record of all the water containers and other potential breeding places at each and every place or premises in the section of the overseer is kept. He is required to make an entry into this book as to the condition of these breeding places on the day he visits the place. Defects have to be noted and reported. If any mosquito breeding is detected he has to take steps to destroy it immediately and to report it. At the same time a note of breeding is made in the book. The overseers submit all

their reports to the Malaria Head Office through their Malaria Inspectors.

As regards the duties of the coolies they are not required to do any work independently. Two coolies accompany an overseer for his daily routine inspections and assist him in finding out mosquito breeding, collecting larvae samples and in destroying the breeding with suitable larvicides or other measures.

The mukadams have to attend to several things such as the preparation of oil mixture, Paris Green mixture, stocking of wells with fish. The mason and carpenter attend to such minor defects in the water containers or wells as could be easily remedied without calling upon the owners to do so.

The Malaria Officer is responsible for the working of the whole department. He directs the policy of the department with the approval of the Executive. Health Officer as regards all anti-malarial measures. He is assisted by a clerical staff.

There is a small laboratory attached to the Malaria office where the work done is mostly identification of anopheline larvae and examination of blood slides for malaria parasites.

Whenever Anopheles breeding is detected anywhere in the daily routine inspection of the overseers, the Malaria Inspectors are required to send samples of these larvae to the laboratory with full particulars as regards their source. The larvae are carefully examined and whenever a sample is identified as that of an Anopheles stephensi, intimation is immediately given to the Malaria Inspector of the ward, of the result of identification; and he is directed to take necessary steps to prevent or stop the breeding. The aim of the Malaria Department is to direct all its activities in this way towards the eradication of the malaria carrying mosquito of Bombay i. e. the Anopheles stephensi without in any way ignoring the annoyance caused by all other kinds of mosquitoes. In Bombay the war is therefore against mosquitoes in general but against Anopheles stephensi in particular.

The following species of Anopheles mosquitoes are found in Bombay :—

Anopheles subpictus (rossi)

" *stephensi*

" *vagus*

" *barbirostris*

" *fuliginosis*

" *culicifacies*.

J. S. NERURKER.
R. K. MHATRE.

GEOLOGY.

The island of Bombay is separated from the island of Salsette by tidal creeks and alluvial flats whilst the expanse of water forming Bombay harbour lies between it and the mainland to the eastward. The island itself consists mainly of two ridges running southwest, to northeast one from Malabar point to Worli and the other from Colaba point to Sion. These ridges are composed of the Deccan Trap and are separated by alluvial deposits and littoral concrete. The ridges and the flats point to two distinct periods in the formation of the island: first, the period of volcanic activity, for the alluvial deposits are always on the top of the trap, and secondly, the period of denudation and aqueous deposition. (See Map.)

Volcanic Period.—During the first period volcanic activity was not restricted to Bombay and its neighbourhood; but about the end of Cretaceous times, there was a tremendous out-burst of volcanic activity which continued up to the Middle Eocene and covered the Indian Peninsula with lava flows which are known as the Deccan Trap. These bedded basalts extended at one time throughout nearly 10° of latitude and 16° of longitude and over the greater portion of their present area; the most remarkable characteristic is their persistent horizontality. This is conspicuous on the Western Ghats and the whole of the Deccan. The only places where the Trap dips, are the Satpura and Rajpipla hills and along the coast near Bombay. This disturbance, as shown by the later sedimentary beds being involved in the movements, is of a much later date. In the islands of Bombay and Salsette they have an inclination of 5° to 10° to the westward. In the islands of the harbour and in the hills between Thana and Kalyan north of the harbour, the same

westwardly slope is visible but further to the eastward towards the Ghat, the traps are horizontal. About 2,000 ft. of horizontal beds are displayed by hills of Matheran and still greater thickness on the flanks of the hills of the Bhor Ghat. Taking the average dip of the Traps near the coast to be 5° the whole thickness would be nearly 7,000 ft. as a minimum estimate; 10,000 ft. would be nearer the mark. About 1,200 to 1,500 ft. of rocks are exposed in Bombay so that it is evident that the lowest beds seen on the island are higher in the series than the highest flow on the Western Ghats, although some of the higher portions (Mahableshwar) are 4000 ft. above the sea. *

Volcanic Rocks, Antop Hill Trap.–The lowest of the volcanic lavas, exposed in Bombay, are on the eastern side of the island at Rowli Hill, Matunga, Antop Hill, Sewri and Cross Island in the harbour. It is described as black jasper or chert, a hard rock which stands out as hills amongst the salt-pans. This rock is probably due to secondary changes in the original earthly composed Traps.

Volcanic Breccia.—Then follow the Volcanic breccia which form a continuous track from Carnac Bunder to Sion. These were formed of the accumulation of volcanic ash, and block scoriæ which they contain weather out, remaining in relief. Good examples are seen at Rai Hill at Parel and in the neighbourhood of Sion Fort in Bombay. (Kanheri caves of Salsette are carved out of the same kind of beds.)

The Amygdaloidal Gray Traps.—On the top of these are the Grey Traps which are amygdaloidal in parts stretching from Colaba to Reva Fort. These basalts are interstratified with volcanic tuffs as at Rai Hill, Parel, and with lacustrine deposit at Nowrojee Hill, Matunga, and near the Byculla Club. The chief characteristics of the amygdaloidal basalt are the nodules, chiefly of zeolites very often covered with glauconite. Some times there are good porphyritic crystals of glassy felspar. The lacustrine formations are all shaly beds not unlike the beds under Malabar Hill; and only one, that at Nowrojee Hill, has given Cyprides. Fossils have not been found in the others.

* Dr. Buist, Dr. Carter and Mr. Hislop regarded the Bombay Traps to be of the same age as the Lower Traps and the dip in Bombay to be due to a great sheet of intrusive rocks.

The Bombay Inter-trappeans.—Then come a series of traps which are hidden by the alluvial deposits between the two ridges. The formations that follow are the highest known fresh water beds of the Traps. These are exposed under the basalt of the ridge running right from Malabar'point to Worli. The base of these beds is not exposed, but on the east side the thickness is more than 100 ft. in places, and they consist chiefly of earthy shales greyish blue and brownish yellow in colour. Sometimes there are highly bituminous hard pans which are black and carbonaceous and contain layers of a coaly substance and fragments of resin. The greater portion of the formation is evidently made of volcanic detritus, lapilli washed down by water and sand produced by the disintegration of the basalt.

Fauna and Flora.—The Bombay inter-trappeans are fairly fossiliferous. Skeletons of a fresh water tortoise *Hyaraspis Leithi* and a frog *Rana Pusilla*, considered an Oxyglossus by Stolickza, are characteristic of the formation. The carapaces of Cyprides representing the Arthropoda are also abundant, while the Mollusca are rare. Plant remains discovered are badly preserved impressions of seeds, leaves, stems, etc. The fauna represented by the species named is chiefly that of a shallow marsh. Frogs are numerous and their skeletons perfectly showing that they were probably deposited near the spot where they died. In some cases there is evidence of the skeleton being dragged along the surface of the shale in which it is embedded and Stolickza suggests, with great probability that this was done by the wind. It is not difficult to conceive that due to the lava-flows the drainage of the country was disturbed and valleys and streams were dammed up to produce shallow lakes. The largest revealed in Bombay is the one stretching from Malabar point to Worli, while small ones are at a lower horizon at Nowrojee Hill, Matunga and near Byculla Club.

The highest trap.—The basalt overlying the fresh water bed is the highest lava-flow known to occur in the Trap area and must have been much thicker than it is now. It is 90 feet thick on the eastern side resting on the lacustrine beds, and 51 ft. on the west where it runs out into the sea to an unknown distance. The most compact and stratified flow is at Malabar Hill and sometimes in its scarped portion it presents a columnar structure.

The prevailing rock is a blue basalt and is not unlike the basalt which we have described as the Grey Trap of Colaba and Reva.

Period of Aqueous deposits.—After the deposition of Traps began a period of denudation when several thousand feet of basalt were washed away seawards. This denudation was aided by the slow encroachment of the sea. The disturbances in the extra-peninsular area which raised the Himalayas, had their counterpart in the peninsular area, tilting the plateau so that the dry land to the westward was depressed and to the east was elevated. The sea encroached upon the land and combined with the peculiar action of the monsoon produced the cliffs that are known as the Western Ghats. After the carving out of the Konkan plane, the sea retreated and subsequent denudation wiped out traces of marine deposition. But upto a much later time the hills of Bombay Island were separated by estuaries and sufficient time has not elapsed yet, for some of the deposits laid down then, to be washed away. Bombay then consisted of a group of islands and the whole coast had a large number of inlets. A few creeks and Bombay harbour still remain but they are gradually being silted up.

The existence of these old estuaries is revealed by the alluvial flat which stretches from Grant Road to Mahim separating the two Bombay ridges. These alluvial deposits are of yellowish brown and blue clay. The former appears to be the older of the two. Its surface is above the sea level and abounds in large masses of kankar and occasionally yields estuarine shells. The blue clay varies in thickness from a few inches to several feet and contains a large quantity of salt, nodules of kankar and plates of gypsum and is occasionally penetrated by mangrove roots. These estuarine deposits are of the same nature as the mud now laid down in the Bombay backwaters and the harbour.

The most recent formation is the littoral concrete forming the flat surface of the Esplanade and the coast of Mahim. It rests sometimes on the trap but more often on the blue clay and consists of sand and pebbles with marine shells and corals consolidated by a calcareous cement.

Recent oscillations of level.—This calcareous grit points to a recent upheaval of the Esplanade and the coast of Mahim,

while the evidence of subsidence is furnished by the excavations at Prince's Dock where a large number of roots and stems have been found in the blue clay, many in the position in which they grew and some 30 ft. below high water mark.

S. N. MOOS.

BOTANY.

(1926–1933)

The study of the vegetation of the Bombay Island began in the sixteenth century when the owner of the Bombay Island, Garcia d' Orta, a botanist from Lisboa, came to India in 1538. A good historical account of the study of the Bombay flora was written by Rev. E. Blatter, S. J., Ph. D. in the Souvenir volume issued by the Indian Science Congress Association when it last met in Bombay in 1926. Since then the flora of the Bombay Island and of the whole Presidency has been very critically studied. The flora of the Bombay Presidency was completed and published by T. Cooke in 1908, and he was followed by W. A. Talbot's flora of the Bombay Presidency in 1911. The ferns of Bombay were studied by E. Blatter and J. F. R. d' Almeida and a monograph on the subject appeared in 1922. The flora of the Indus Delta was studied by Blatter, C. McCann and T. S. Sabnis and was published in 1927, in a serial form in the then Indian Journal of Botany (now the Journal of the Indian Botanical Society.)

Since the publication of the Flora of the Bombay Presidency by Cooke, a number of monographs of various orders and genera has appeared from time to time, revealing a more critical interest. This periodical appearance of the scattered papers necessitated a complete revision of the Bombay flora so as to bring it up-to-date. This was taken up by E. Blatter who has done more than any one else in enlarging our knowledge of the flora of the Presidency, not to mention his work on the flora of Baluchistan and other places in India. The revision of the Bombay flora was undertaken in 1926 and the results are being published in the Journal of the Bombay Natural History Society ; twenty one parts have already appeared. In the revision of some of the orders, Blatter was assisted by his colleague McCann and several new species have been described by them in the

same journal, as well as in the Journal of the Indian Botanical Society. Prof. F. H. Halberg also collaborated with Blatter in the publication of some new species.

The work on " Bombay Grasses " was first published by Dr. Lisboa but it was far from complete. The Bombay grasees are being revised by Blatter and McCann and many changes in the nomenclature are introduced by them. A monograph on the Bombay grasses by Blatter and McCann is in course of publication by the Publication Section of the Imperial Council of Agricultural Research.

A good beginning has been made in the study of Cryptograms. In 1927 at the suggestion of Professor V. N. Hate and others, the Bombay University invited Dr. F. Borgesen of Copenhagen, to collect and identify the marine algae of the shore of the Bombay Presidency so that it may form a basis for algal study, as well as provide training for Botanists here interested in that study. He made collections from Bombay, Dwarka and Karwar. The collections are being gradually identified by him at Copenhagen and some of them have already been published in the Journal of the Indian Botanical Society and in the *Bulletins of the Royal Botanic Gardens.* Some papers dealing with Characeae and Caulerpa also have been published by S. C. Dikshit

A new department of microbiology has been opened at the St. Xavier's College since 1929, with the Rev. G. Palacios S. J., D. D., Ph. D. as the Director, where a beginning has been made to study the micro-flora of the Bombay Soils and to study the chemical and microbiological processes in the weathering of the soils.

There is a belt of mangrove vegetation at the northern end of the Bombay Island and it becomes broader on its eastern side. The physiological anatomy of the Indian halophytes is studied in detail by D. P. Mullan and some papers dealing with the subject have already appeared in the Journal of the Indian Botanical Society. The mangrove vegetation in the Thana Creek and near Ghodbunder is richest in species. Eight different species of mangroves are found in this tract.

Plant Physiology. — The Botany Department of the Royal Institute of Science is equipped for research in plant physiology

and research work in different aspects of the Rice Physiology, physiology of photosynthesis, protein synthesis, respiration and of other allied subjects is at present carried out.

Botanical Collections. — There are four herbaria in Bombay; one at the Bombay Natural History Society's rooms (6, Apollo St. Fort.), the second at St. Xavier's College (Cruickshank Road, Fort), the third at the Botany Department, Royal Institute of Science (Mayo Road, Fort); The fourth is the private collection of Mr. C. McCann, F. L. S., Assistant Curator, Bombay Natural History Society.

R. H. DASTUR.

SOME INTERESTING ECONOMIC PLANTS IN THE VICTORIA GARDENS.

Acacia Catechu, var *Sundra Prain.* (Leguminosæ)—Catechu or Cutch tree. An Indian tree, the heartwood of which furnishes *Catechu* or *Cutch*, a powerfully astringent substance used medicinally and in tanning.

Achras Sapota, Linn. (Sapotaceæ)—Noseberry or Sapodilla. A tropical American tree bearing sweet fruits with a brown rind. The fruit is so much in demand in Bombay that it is now commonly cultivated in almost all gardens.

Adansonia digitata, Linn. (Malvaceæ)—Baobab or Monkey-bread tree. A remarkable looking tropical African tree noted for the great age to which it lives—said to be up to about 5,000 years, and also for the thickness of its trunk. The fruit is very large, woody, oval, with a rind similar in texture and colour to that of the tamarind pod, containing an agreeable acid pulp which is used for making a cooling sherbet in the hot weather.

Ægle Marmelos, Corr. (Rutaceæ)—Bael tree or Bengal Quince. A small spinous tree, native of India and sacred to the God Shiva. It bears hard, woody, globular fruits with a pale green shell. The stiff pulp of the fruit containing masses of clear mucilage is a reputed specific for dysentery taken in the form of a sherbet or conserve.

Aeschynomene aspera, Linn. (Leguminosæ)—Sola plant. A marsh shrub of India not common in the Bombay Presidency,

but very common in Bengal, the remarkable light and spongy pith-like stems of which furnish the *sola* of India used for making sola hats and floats for fishermen, etc.

Artocarpus incisa, Linn. (Urticaceæ)—Bread Fruit tree. A relative of the well known Jack Fruit tree, native of the Pacific Islands, bearing at the ends of branches large round or oval fruits of the size of a melon with a solid mass of fleshy pulp which sliced and roasted or fried forms an excellent vegetable, and roasted and ground into flour forms the principal article of diet of the natives of the South Sea Islands.

Bamboos.—Among the bamboos in the Gardens the following are worth noting:—

> *Bambusa vulgaris,* var *striata, Gamble* (Gramineæ)—A very ornamental variety of bamboo, native of China and Japan, probably the result of cultivation. The stems are bright golden yellow marked with vertical green lines.
>
> *Dendrocalamus giganteus, Munro* (Gramineæ)—Giant bamboo. This is, perhaps, the largest bamboo known, native of Burma and Malaya. A magnificent species attaining a height of over 100 feet with stems up to 8 inches or more in diameter.
>
> *Melocanna bambusoides, Trin.*—(Gramineæ) A fine thin straight unbranched bamboo. bearing seeds as large as olives quite unlike the seeds of other bamboos.

Bassia latifolia, Roxb. (Sapotaceae)—Mohva tree. A very useful deciduous tree of India. The fleshy flowers are largely eaten, and yield by distillation a spirit — the *Mohva* liquor — The oil extracted from the kernel of the fruit is edible and is also used for soap making.

Bixa Orellana, Linn. (Bixineæ)—Arnatto. A quick growing large shrub of tropical America and cultivated throughout India. The bright crimson covering of the seeds yields the *Arnatto dye* used for dyeing silk, etc., and also for colouring butter, cheese, etc., by dairymen.

Broussonetia papyrifera Vent. (Urticaceæ)–Paper Mulberry or Tapa cloth. A small tree growing wild in China, Japan and also in many of the islands of the Pacific Ocean where the natives

manufacture a large part of their clothing from its bark. From the bark of the tree the Burmese make their curious papier mache school slates (*Para baik*). The *Tapa-cloth* of the South Sea Island and the Karen's *Mulberry paper-cloth* are also made from it.

Butea frondosa, Konig. (Leguminosæ)—Bengal Kino or Palas. A small deciduous tree indigenous to the forests of the dry regions of India. The bark yields an astringent resin used for tanning and medicinal purposes.

Cæsalpinia coriaria, Willd. (Leguminosæ)-American Sumach or Divi-divi tree. A small spreading tree of central America and West Indies, the small twisted pods of which form the *Dividiri* or *Libi-dibi*, highly valued in Europe as a source of tannin.

Cananga odorata Hook. (Anonaceae)—Ilang-Ilang. A quick growing tree, native of the Philipines, Java, etc., with large greenish-yellow strongly scented flowers, which yields on distillation, the popular scent *Ilang Ilang* or *Ylang Ylang*.

Cassia alata, Linn. (Leguminosae)—A large spreading shrub introduced in this Presidency perhaps from the West Indies, extremely handsome with its bold foliage and terminal cone-shaped racemes of closely packed large deep yellow flowers. The leaves have a high repute as a local application in skin diseases, specially ringworm.

Cassia fistula, Linn. (Leguminosae)—Indian Laburnum or Pudding-pipe tree. A small upright deciduous tree common throughout the Presidency in dry regions and well known to Europeans as the Indian Laburnum. The pendulous, cylindrical, shining black pods from 1 to 2 feet in length, contain a blackish brown, viscid, sweetish pulp which is used as purgative under the name of *Garmal*.

Castanospermum australe, A. Cunn. (Leguminosæ)—Moreton Bay Chestnut. A moderate sized handsome tree, native of Queensland, bearing large peculiar fruits, the seeds of which are similar in appearance to, and when roasted resemble in flavour the chestnut, though much inferior to it.

Chrysophyllum Cainito, Linn. (Sapotaceæ)—Star-apple. A very ornamental West Indian tree with a graceful habit. The round smooth fruits from 2 to 3 inches in diameter contain a

white jelly-like substance surrounding the seeds which when ripe is somewhat agreeable in taste.

Cinnamomum camphora, Nees. (Laurineæ)—Camphor tree. A moderate sized evergreen tree, native of Formosa, China and Japan. *Camphor* is obtained by dry distillation of the wood, leaves and root of this tree.

Cinnamomum zeylanicum, Blume, Bijdr. (Laurineæ)—Cinnamon tree. A medium sized evergreen tree, native of Ceylon and Java. The bark of the young shoots slit longitudinally and removed form the *cinnamon* of commerce. The leaves are aromatic giving oil of cinnamon.

Coffea arabica, Linn. (Rubiaceæ)—Coffee plant. A large woody shrub of tropical Africa, the ripe berries of which furnish *coffee.*

Coffea liberica, Bull et Hiern. (Rubiaceæ)—Liberian Coffee plant. A native of west tropical Africa, is a robuster plant thriving at lower elevations and bears larger beans though of inferior flavour than the Arabian Coffee plant.

Crescentia Cujete, Linn. (Bignoniaceæ)—Calabash tree. A small tree native of the West Indies and tropical America. The fruit resembles a pomelo in appearance having a very hard rind, which, after the removal of pulp which is said to possess medicinal properties, is used in South America as a domestic vessel.

Croton Tiglium, Linn. (Euphorbiaceæ)—Croton-oil plant. A large shrub native of India and China, and naturalized in South Konkan, from the seeds of which is obtained *Croton oil* (*Jamalgota*) which is a drastic purgative.

Cyperus papyrus, Linn. (Cyperaceæ)—Egyptian Papyrus. An ornamental large Egyptian sedge growing in swamps and on water margins, is suoposed to be the bulrush of which the ark of the child Moses was made. The ancients made paper from the pith of its stems by cutting them into thin slices, laid side by side and heavily pressed after sprinkling them with gummy water.

Erythroxylon Coca, Lam. (Lineæ)—Coca or Cocaine plant. A small handsome shrub native of Andes and Peru with leaves

of a pleasant light green colour, small white flowers and handsome red berries. The leaves are used by the American Indians with a little unslaked lime as a masticatory which acts as a gentle stimulant enabling them to do hard work on little food. The active principle contained in the leaves is *Cocaine* the well known anæsthetic for superficial surgical operations.

Eugenia caryophyllata, Thunb. (Myrtaceæ)—Clove tree. A small conical tree, native of the Moluccas and cultivated in southern India. The dried unexpanded flower buds of this tree form the *cloves* of commerce.

Eugenia Jambos, Linn. (Myrtaceæ)—Rose-apple. A moderate sized handsome tree, native of India and Malaya bearing fragrant pinkish white fruits of the size of a small apple having a sweetish-acid taste.

Eugenia javanica, Linn. (Myrtaceæ)—Wax' Jamboo or Jamrul. A small Malayan tree producing clusters of pretty, shining, pinkish white, waxy looking fruits.

Eugenia malaccensis, Linn. (Myrtaceæ)—Malay-apple or Malacca Jamb. A very handsome tree of the Malay Islands with large, leathery, oval leaves, producing a great profusion of beautiful crimson flowers followed by pear-shaped bright red edible fruits.

Garcinia indica, Chois. (Guttiferæ)—Kokam-butter tree. A small Indian tree, bearing globose purplish fruits resembling the Mangosteen, having an agreeable acid flavour, used in making curries, etc. From the seeds is obtained a solid oil known as "*Kokam-butter*" used in India for healing chaps and abrasions.

Garcinia xanthochymus, Hook, f., (Guttiferæ)—A symmetrical cone-shaped bushy tree, native of south India and Malaya, producing handsome yellow fruits of the size of a small orange, the juicy pulp of which is of a strongly acid but refreshing taste and also yields an indifferent gamboge.

Guaiacum officinale, Linn. (Zygophylleæ)—Lignum Vitæ tree. A very small slow growing West Indian tree, one of the very best large shrubs in the Gardens, both on account of its dark green glossy foliage and very beautiful cuplike flowers dark blue at first, turning pale afterwards. This plant yeilds the

Lignum vitæ, a greenish brown, hard heavy wood extensively used by turners, and also the fragrant gum *guacium* used medicinally.

Hæmatoxylon campechianum. Linn. (Leguminosæ)—Logwood tree. A small slow growing Central American tree bearing thick spikes of fragrant yellow flowers. The heartwood yields the *logwood dye* valuable in the manufacture of woollen and silk goods.

Hippomane Mancinella, Linn. (Euphorbiaceæ)-Manchineel tree. A West Indian tree containing an acrid poisonous milk which the natives use for poisoning their arrows. The milky juice produces temporary or total blindness by the slightest touch of it to the eyes or even if one sits over a fire made from its wood.

Ilex paraguayensis, St. Hilaire (Ilicineæ).—Mate or Paraguay tea. A small bushy evergreen tree of Paraguay with large shining green leaves similar to those of the tea plant extensively used in South America for the same purpose as tea is used here, containing the same active principle as tea but without the injurious tannic acid. An infusion made with boiling water of the leaves dried or roasted over a wood fire has an agreeable aromatic odour and slightly bitter taste.

Macadamia ternifolia. F. M. V. (Proteacæ)-Queensland Nut tree. An ornamental small evergreen tree from eastern Australia bearing hard nuts of the size of marbles, containing a white firm kernel as crisp as that of the hazel nut with a rich agreeable flavour resembling that of the filbert.

Meleleuca leucadendron Linn. (Myrtaceæ)—Cajuput-oil tree. A large tree of the Malay Islands and Australia with the trunk covered with a thick, light, spongy, brown and white bark, peeling off in layers. The leaves of the variety minor yield the *Cajuput oil* which has a considerable reputation as a rubifacient and counter-irritant in muscular rheumatism. This tree is considered suitable for planting in malarious swamps in tropical countries.

Manihot utilissima Pohl. (Euphorbiaceæ)—Cassava or Tapioca plant. A tropical South American herbaceous peren-

nial large shrub, the long tubers of which yield a valuable starchy food called *Tapioca*, after their poisonous juice containing prussic acid is destroyed by pressing and washing the grated root and subsequently heating it.

Mimusops hexandra; Roxb, (Sapotaceæ)—Rayan on Khirni. A large evergreen tree common in the Deccan Peninsula. The ripe yellow berry though very astringent is eatable and sold in the Bombay Market as *Amdabadi Meva.*

Murraya exotica Linn. (Rutaceæ)—China Box or Satin Wood plant. A very handsome, evergreen large bushy shrub with glossy dark green foliage resembling a box-tree and bearing a profusion of deliciously scented orange-blossom like white flowers. The wood resembles box-wood and is used for wood engraving.

Myristica fragrans, Houtt. (Myristicaceæ)—Nutmeg tree. A moderate sized tree of Moluccas bearing pale amber fruits resembling an apricot in appearance which when ripe slit open and disclose the hard brown seed—the *nutmeg* cf commerce-surrounded by a network of scarlet aril which is the spice known as *Mace.*

Myroxylon Toluiferum, H. B. K. (Leguminosæ)-Tolu Balsam tree. A South American evergreen tree with handsome dark green foliage. An incision into the bark of the tree yields the drug known as *Tolu Balsam* similar to the Balsam of Peru possessing mild stimulant and expectorant properties.

Palms.—Among the several kinds of palms, economical and ornamental, in the Gardens, the following may be noted:—

Arenga saccharifera, Labill. (Palmeæ)—Sugar Palm or Gomut Palm. A beautiful palm, native of the Eastern Archipelago with large, dark green, shining leaves which take a graceful plume-like curve towards the summit. It is one of the sources of Palm sugar or *Jaggery.* Sago is obtained from its stem and the palm yields a black horse-hair like fibre called *Ejoo* or *Gomuti* used by the Malays, for coarse cordage and brush making.

Attalea Cohune (Palmeæ)—Cohune Palm. A Brazilian palm with stiff erect leaves like those of the Cocoanut, the hard bony fruits of which are used for turning into fancy articles.

Corypha umbraculifera, Linn. (Balmeæ).--Talipot or Fan palm. One of the largest, most stately and beautiful member of the palm family, native of south India and Ceylon, with gigantic orbicular leaves, used for making mats, fans, umbrellas etc., and for writing, forming the material on which some of the oldest Sanskrit manuscripts were written. This palm, like some other palms, flowers once in from 20 to 40 years and then dies down. The hard ivory-like seeds called *Bajurbet* are used in turnery for making buttons, beads, etc; they are edible when tender.

Elœis Guineensis, Jacq. (Palmeæ)—A tropical West African palm, of great economic importance, the fruits supplying the natives with a favourite article of food, the stem yielding an intoxicating drink, and the fruit kernels a valuable commercial oil.

Pandanus utilis, Bory. (Pandanaceæ)--A species of the screwpine, native of Madagascar and a common wild plant in Mauritius where it is called *Vacua* or *Bacua* and its leaves used for manufacturing sacks for exporting sugar.

Phyllanthus disiichus, Muell, Brg. (Euphorbiaceæ)—Star-gooseberry. A small tree, native of India and Malaya with graceful feathery leaves and bearing pale green round and ribbed acid fruits used for pickling and preserves.

Phyllanthus Emblica, Linn. (Euphorbiaceæ)—Emblic Myrobalan or Ambla. A medium sized deciduous Indian tree with graceful feathery foliage, bearing smooth, round, fleshy, pale yellow, astringent fruits of the size of marbles which conserved in sugar are much esteemed as a cooling laxative and useful in dyspepsia.

Quassia amara, Linn. (Simarubaceæ)—Surinam Quassia tree. A small handsome tree attaining only a spare shrubby growth here. The whole plant contains a bitter principle and the wood furnishes the well known *Quassia chips* used for medicinal purposes as a tonic and also as an insecticide by gardeners.

Rubber Trees — The best of all rubber trees Para Rubber (Hevea braziliensis, Euporbiaceæ)—has failed to grow in the Gardens, but specimens of the following kinds can be seen :—

Castilloa elastica, Cerv. (Urticaceæ)—Central American Rubber tree. A quick growing tall tree of Central America producing rubber in quality next to Ceara Rubber. It does not thrive well in the Gardens.

Ficus elastica, Roxb. (Urticaceæ)—India Rubber tree. A very large spreading, handsome, Indian tree, with oval, leathery, shinning leaves, yielding good rubber but taking comparatively long to attain a tapping age.

Manihot Glaziovi, Muell. (Euphorbiaceæ)—Ceara Rubber tree. A small quick growing tree of South America thriving at medium elevation and in drier climate than does the Para Rubber tree, and yielding a satisfactory return of rubber second in quality only to Para Rubber. It grows well in the Gardens.

Sapindus laurifolius, Vahl. (Sapindaceæ)—Soapnut tree or Soapberry. A tree indigenous on the Ghats of N. Kanara and cultivated throughout India. The fleshy berries are commonly used as a soap for cleaning clothes.

Silk-Cotton Trees. — The following three silk-cotton trees are represented in the Gardens :—

Bombax malabaricum, D. C. (Malvaceæ)—Sa'war or Silk-Cotton tree. A large deciduous tree with wide spreading branches found throughout the Bombay Presidency and a very conspicuous object in the cold season with its numerous large, bright red, cup-like flowers. The numerous seeds contained in its large pods are enveloped in a downy heap of white silky hair which is known as *Simul* and forms an excellent material for filling beds, cushions and pillows.

Cochlospermum Gossypium, D. C. (Bixineæ)—Guneri or Yellow Silk-Cotton tree. A small deciduous tree, native of the dry hills and forests of Central India and very rare in Bombay, where it does not seem to thrive well. The seeds contained in the five lobed capsular fruit are covered with an abundance of pure white floss like the Sa'war.

Eriodendron anfractuosum D. C.(Malvaceæ),—Safed Sa'war or White Silk Cotton tree. A tall deciduous tree with a straight tapering trunk, is also rare in this Presidency being found wild

only in Khandesh. The seeds of this tree are also covered with copious silky floss used for the same purpose as that of· Bombax but of greater commercial value and is imported into Europe under the name of *Kapok*.

Swietenia Mahagoni, L. (Meliaceæ)—Mahogany tree. A large spreading valuable timber tree of South America with handsome foliage, and famous for its wood used for furniture making. It thrives well here.

Theobroma Cacao, Linn. (Sterculiaceæ)-Cacao, Cocoa or Chocolate tree. A woody shrub of South America, bearing large warty red pods on the stem and branches, containing large seeds which when roasted and ground down to a paste with sugar, starch, vanilla, etc, form the *cocoa* and *chocolate* of commerce.

Plumeria acutifolia, Poir and *Plumeria Rubra* (Apocynaceæ) white and red flowered Temple or Pagoda Trees (Khair & Lal Champa) respectively. They yield a quantity of white latex or milky juice. The bark and the milky juice are used in Indian medicine.

Carludovica palmata, Ruiz and Pav. (Cyclanthaceæ)-Panama Hat Palm, a stem-less, palm-like bush with large palmate leaves, similar in appearance to the Fan-Palm with stalks 5-6 ft. in length, a native of Tropical America. Panama Hats are made from the leaves.

Ananas sativus Schult (Bromeliaceæ)—Ananas or Pine-apple and Ananas sativus Var: varigata, native of Tropical America. The fruit is most delicious and very much prized.

Anona reticulata, Linn. (Anonaceæ) Bullock's Heart— ' Ramphal ', a small tree native of tropical Asia and America and very common in India. It is not so fine and delicate in flavour as the Custard Apple (Anona squamosa). The inner bark furnishes fine lac-like fibre, used for wrappers, ornaments, hats, leaves and young twigs are used for tanning.

Asclepias curasavica Linn, (Asclepiadaceæ)—Red Head or Bastard or wild Ipecacuanha or Jamaica wild Liquorica. Erect shrubby perennial of the West Indies (Kuraki or Kakat-

andi). The plant bears erect umbels of orange and yellow, moderate-sized flowers. Fine fibre is obtained from stems used for textile fibres.

Calotropis gigantea Br. (Asclepiadaceæ),—Akado, Madar. An erect shrub common in India and Ceylon. It yields from the stems a fine hemp-like fibre, used for stuffing pillows, etc.

Sansevieria. (Haemodoraceæ)—Bow-string hemp. An African genus (excepting two species said to be indigenous) of hardy perennial plants. They are noted for the valuable fibre they yield. From the stoloniferous stock, cartilaginous sword-like leaves are densely produced and the plants develop rapidly in loose, sandy soil and grow well in a little shade. S. zeylanica, *Willd*, S. cylindrica. *Boj* ; Hort : (Manu) ; S. Guinemsis and S. Iaurentili Hort : (S. Laurentil Widom) are cultivated in the gardens for the beauty of their leaves.

Artocarpus integrifolia, Linn. (Urticaceæ)—Jack Fruit or Fanas, the tree grows to a considerable·height and is found in all parts of India. The fruit is of enormous size, ill-shaped somewhat oval-formed, borne on the trunk and older branches, sometimes down to the base of the trunk. The fruit forms a very important article of food with the·poorer classes. The tree affords an excellent timber, much used for cabinet work, building, etc.

Blighia Lapida Konig. (Sapindaceæ)—Akee. A large tree native of west tropical Africa. The fruit is the size of a small lemon, somewhat ribbed, and is of brilliant vermillion colour when ripe. The tree is cultivated in West Indies principally for the sake of its edible fruit.

Averrhoa Bilimbi, Linn. (Geraniaceæ)—Bilimbi Cucumber tree, a small fine foliaged tree is a native of Moluccas, and is cultivated in the tropics, especially in the East for its fruit, which is about 3 to 4 inches long and resembles small green cucumber. The fruit is much relished in curries, and is esteemed in pickles and preserves and sometimes used for jam and cooling drinks.

Dillenia indica, L. (Dilleniaceæ)—Mota Karmal, a medium sized ornamental tree common in this country, bears very large pure white fragrant flowers, with yellow anthers. Fruits, have

the flavour of a very sour unripe apple, but when cooked with sugar have the flavour of the fruit.

Wrightia tinctaria, R. Br. (Apocynaceæ)–Kala-kura. A small tree, which bears white fragrant flowers. The wood is ivory-white and easily turned, used for the manufacture of toys. Wrightia tinctoria is also used in some parts of India for the manufacture of Indigo.

Hydnocarpus Wightiana, Blume. (Bixaceæ)—Jungli Badam. A common tree of western India, and of great medicinal use. The oil extracted from the seeds, which is similar to the Chaulmogra oil (oil extracted from the seeds of *Gynocardia odhrata.*) It is used as a substitute for Chaulmogra oil for the cure of leprosy and other skin diseases.

Hura crepitans, Linn. (Euphorbiaceæ)–Sandbox Tree. A small armed tree from tropical America, and introduced into this country from Jamaica. It bears round and hard fruit, flattened at both ends. Oil is extracted from seeds, but the properties are not well known. The tree yields a milky–juice, which causes immediate blindness, if applied to the eyes.

Sapium insigne, Trim. (Euphorbiaceæ)—"Dudla." A robust deciduous tree of the Sub-Himalayan tract. The white plant contains acrid milky juice which produces vessication, when applied to the skin. The wood is greyish white, soft and spongy and is used for the cylinders of the Indian drums and for making sandals.

Alstonia scholaris, R. Br. (Apocynaceæ)—" Satvin. " Dita Bark Tree. A tall tree with bitter milky juice, tall stem, often fluted or buttressed base. The bark known as Dita bark is an article of commerce and employed in medicine.

Schleichera trijuga. Willd. (Sapindaceæ)—" Kosamb, " The Lac Tree or The Ceylon Oak. Distributed throughout India. Ceylon and Malay Peninsula. The wood is hard and durable and the oil obtained from the seeds has been employed for the cure of itch. This tree is known as the Lac Tree. The lac which is produced on it is highly prized.

Putranjiva Roxburghii, Wall. (Euphorbiaceæ).—The Wild Olive of India ; "Putranjiva." A medium sized handsome avenue

tree with drooping dark green foliage. The stones of the fruit are made into necklaces and rosaries and put round the children's necks with a view to preserve them from evil; hence the term 'Putranjiva.' The wood is used for turning.

D. S. LAUD.

WILD ANIMALS IN BOMBAY

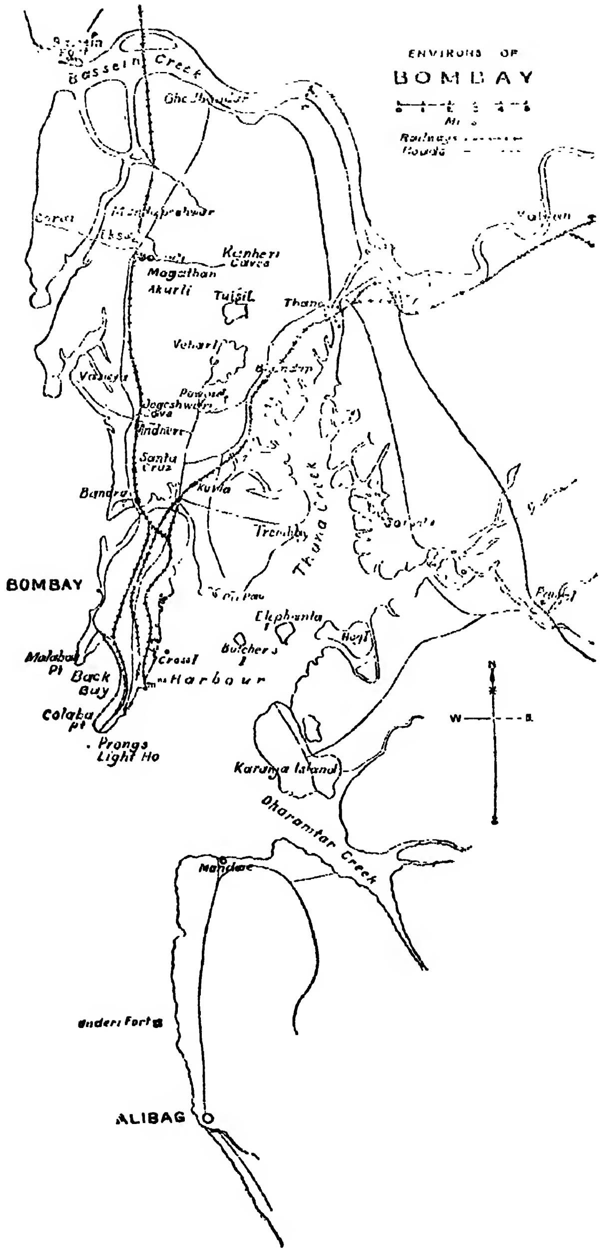
Bombay on account of the dense population of these days is hardly a suitable place for harbouring wild animals. Still venomous snakes are met with even now in different parts of the island. Cobras and Kraits are found practically all over Bombay, while the Russell's viper appears to be a common denizen of the northern part of the island.

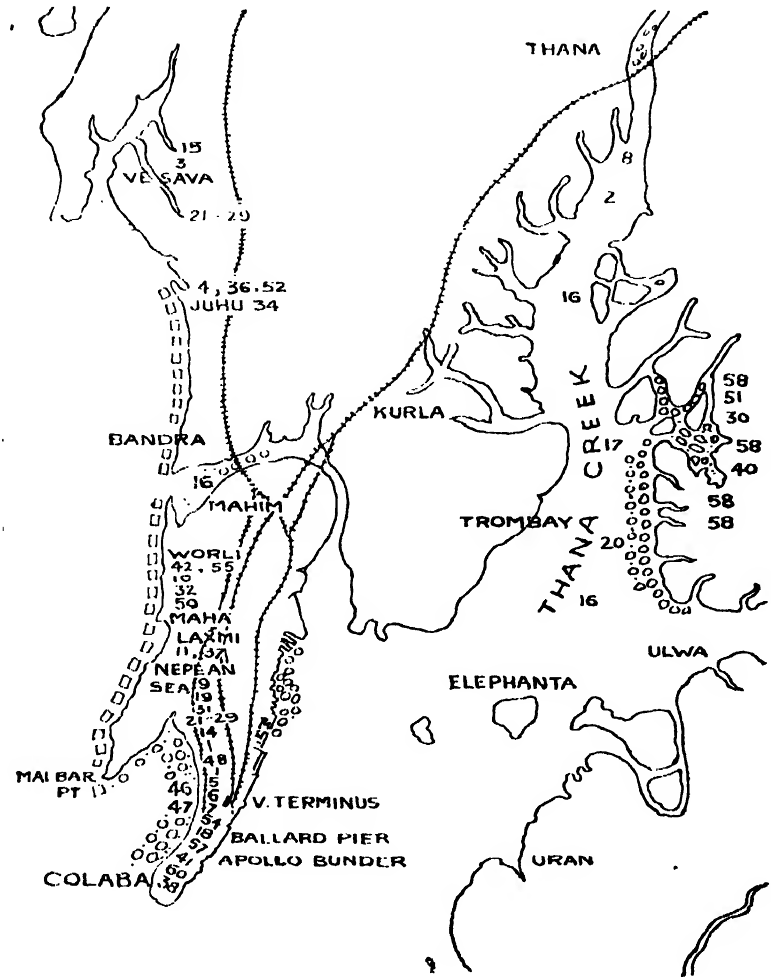
According to Hector Macneill there was abundant wild big game in the immediate neighbourhood, towards the end of the eighteenth century and "the Governor and most of the gentlemen of Bombay used to go annually on a party of pleasure to Salsette to hunt wild boar and royal tiger both of which were found there in great plenty". In 1806 two tigers were seen near General Macpherson's bungalow at Kurla, while only a few days previously two persons were carried off from a village just a little further north, presumably by the same animals. Coming to the Island of Bombay itself we find the following recorded on the 9th February 1822:–"A tiger on Malabar Hill came down, quenched its thirst at Gowalia Tank and ran off over the hill between the Hermitage and Prospect Lodge. Prints of its feet were distinctly visible this morning", Bishop Heber speaks in 1829 of "the occasional occurrence of hyaenas only in Bombay" but the "Bombay Courier" of the same year records the sudden appearance of a tiger at Mazagon. "The animal had apparently swam across the harbour and landed near the ruined Mazagon fort, and thence was driven to the compound of Mr. Henshaw's bungalow where he was eventually shot by the guard of the Dockyard and certain Arabs". In 1830 a large hyaena was seen prowling on the western side of the Malabar Hill and the chase after it was described in the daily papers, "as good sport of a Mazagon tiger". On the 3rd

of March 1858 "some officers of the P. & O. steamer *Aden* observed a tiger swimming from mainland to Mazagaon. A boat was lowered and the crew armed with muskets. When they came up to it the brute was boarding a buffalo, and was being kept off by the lascars by hand pikes. It was shot through the head by six balls". The same year in the month of May a young Portuguese shot a tiger at Mahim. On February 15th 1859 a panther was seen "prowling about the nooks of Kalbadevi Road" but disappeared; it was afterwards shot by Mr. Forjett the Commissioner of Police, "within a few hundred yards of the fashionable drive on the Esplanade, on the beach of Back Bay near Sonapur". On the 5th of December 1860 a hyaena was shot "while devouring a bullock not far from the Byculla Club House". In 1861 hyaenas were quite common at night prowling about the Byculla flats. In 1853 a tiger mauled a Parsi cart-owner at Mahim and did other damage; it was subsequently shot near the Railway station. Recently in December 1907, Mr. Mullen of the Bombay Port Trust shot a tiger near the Sandow Castle at Pir-pau.

Jackals were very common in Bombay in olden days, and were found not only on Malabar and Cumballa Hills, and in the sparsely inhabited northern districts of the island, but the old city walls also used to afford them shelter. Dr. Buist "saw jackals several times in the garden of the Colaba Observatory" in 1844 when he was in charge of the institution; while Mr. Charles Chambers, found one in his bed room in the Observatory about the year 1878. About the same time a jackal was killed in the new High Court Buildings. In the cold season of 1913–14 Major Kunhardt, I. M. S., saw a jackal being chased by pariah dogs between Churney Road Railway station and the Kennedy Sea Face. In the year 1904 a jackal was caught in the St. Xavier's College compound and the Rev. Fr. Blatter informs me that on the 15th November 1918, *i. e.*, fourteen years later, another jackal was captured in the same compound.

A note on Marine animals of Bombay. — The following is a list of animals found in the sea and the creeks around the islands of Bombay and Salsette with notes on their ecology.


ENVIRONS OF
BOMBAY
Basseïn Creek
Kanheri Caves
Mogathan
Akurli
Tulsi L
Thana
Vehar L
Powai
Jogeshwari Cave
Andheri
Santa Cruz
Bandra
Kurla
Trombay
Thana Creek
BOMBAY
Elephanta I
Butcher's I
Harbour
Malabar Pt
Back Bay
Colaba Pt
Prongs Light Ho
Karanja Island
Dharamtar Creek
Underi Fort
ALIBAG
N
W
E



OOO MUD
····· SAND
▯▯▯ ROCKS
O·O·O SANDY MUD

DIGRAMATIC MAP
SHOWING
THE DISTRIBUTION OF INVERTEBRATE ANIMALS
ALONG THE COAST OF BOMBAY

Ground. — The nature of the ground forming the floor of shallow waters plays an important part in determining their fauna. It has been seen in all parts of the world that the sea bottom, whether rocky, muddy, sandy, shingly, or otherwise, has its own characteristic association of marine animals.

(I) *The Creeks.*— The islands of Bombay and Salsette are separated from the mainland partly by the Bassein Creek and partly by the Thana Creek and the Bombay Harbour, and from each other by the Mahim Creek. As no large river pours fresh water into these creeks the salinity of their water is not much lowered. These creeks are broad and shallow and are flanked by wide mud flats and mangrove formations harbouring characteristic animal communities.

(II) *The Sea Shore.*—The sea shore is the strip of land between the high and low tide marks, and provides a rich ground for collecting a variety of zoological specimens. The shore of Bombay and Salsette exposes different geological formations and consists of rocks, mud, sand or shingle at different places. The animals living at different places of this shore show distinct associations closely related to the nature of the ground.

(III) *The Sea Bottom.*—The sea bounding the islands of Bombay and Salsette on the west is a shallow part of the Arabian Sea situated on the Continental Shelf extending along the west coast of India. The slope of the latter is gradual and the 100–fathom line is reached at a distance of 120 miles opposite to Bombay. Outside this line the slope is steep and the Continental Shelf forms the wall of the basin of the Arabian Sea.

The sea bottom of the Bombay waters consists of dark grey clayey mud except for some patches of sand, broken shells, etc. This layer of mud on the Continental Shelf is the accumulated sediment washed down by the rains from the western slope of the Western Ghats and carried away by streams for countless years. Patches of coral reef forming a coral zone on this expanse of mud are at or beyond the 40–fathom line.

ANIMALS.

(*1*) *Swimming Animals.*–

(*a*) *Edible fish.*—The local fishermen have so far confined their fishing to the coastal waters, though during fair weather

some of them have ventured out in their sailing boats for fishing on the open sea not far from the coast. But now a rapid development of the fishing industry is expected as the Bombay Government has recently inaugurated their fisheries scheme for showing the fishermen the advantages of using motor boats instead of sailing boats in fishing operations and also for training them in the manipulation of power boats.

The following is a list of edible fish from the sea and the creeks of Bombay :—

Ghol (*Sciaena Spp*). Its swim-bladder is used for Isinglass preparations.

Saranga (*Stromateus cinereus*). This fish is considered a delicacy. White Pomphret.

Ravas (*Polynemus indicus* and other species). Indian Salmon.

Karel (*Pristipoma maculatum*).

Khajura (*Lates calcarifer*). An estuarine fish

Wam (*Muraenesox talabonoides*). Bombay eel.

Tambusa (*Lutjanus johnii*).

Shingala (*Arius Spp.*) Cat-fish.

Dori (*Sciaenoides brunneus*).

Chand (*Drepane punctata*).

Wagli (*Trygon Spp.*) Rays.

Palu (*Chrysophrys berda*).

Lal Palu (*Pagrus spiniferi*).

Surmai (*Cybium lineolatus*).

Bhakas Flat fishes.

Mushi (*Carcharias Spp.*) Sharks.

Kaneri (*Zygaena So.*) Hammer-headed sharks

Kandere (*Pristis Sp*).

Lanj (*Rhynobatus Sp.*).

Datridhume (*Otolithus ruber*).

Saundala (*Lactarius delicatulus*).

Lalbi (*Caranx malabaricus*).

Bangda (*Scomber mircrolepidotus*).

Bangda (*Synagris Sp*).

Nivta (*Boleophthalmus Spp.*) Mud Skipper.

Chorbombil (*Saurida tumbil*).

Bombil (*Harpodon nehereus*) Bombay Duck.

Kanta (*Pellona Sp.*)

(b) *Other Animals.*-Sea-serpents, Tetrodon spp., Cephalopods, Prawns, Shrimps.

(2) *Bottom Animals.*—Protozoa.-Foraminifers.

Coelenterata.—(3) Halocordyle Obelia, (4) Campanularia (5) Sertularia, (9) Actinia, (10) Bunodes, (11) Zoanthus, (12) Cerianthus, (13) Edwardsia, (14) Pennatula, (15) Cavernularia, etc.

Platyhelminthes.—Various Polyclads.

Nemertines.—Lineus and other genera.

Annelida.—(21) Nereis, (22) Polynoe, (23) Hesionus, (24) Glycera, (25) Eunice, (26) Amphitrites, (27) Sabellids, (28) Spirorbis, (29) Serpulids, (30) Pectinaria, etc.

Gephyrea.—(31) Thalassema, (32) Phymosoma, Dendrostoma.

Polyzoa.—(33) Flustra, (34) Crisia, etc.

Arthropoda.—(36) Eupagurus, (37) Scylla, (38) Palinurus (39) Squilla, (40) Pinnoteres, (41) Balanus, (44) Argulus, (45) Cymothea, and numerous other small Crustaceans including (43) Isopods and (42) Amphipods.

Echinodermate.—(46) Asterias, (47) Asterina, (48) Astropecten, (49) Holothurians, (50) Cucumarians, (51) Echinus, (52) Antedon with Myzostomum, etc.

Mollusca.—(53) Turbinella, (54) Aplysia, (55) Patella, (56) Cyprina, (57) Chiton, (58) Placuna (Pearl shell), (59) Teredo, (60) Ostrea spp., etc.

Brachiopoda.—Lingula.

(3) Drifting Animals.—

Protozoa.—Noctiluca, Dinoflagollates, etc.

Coelenterata.—Varous Hydro-, Scypho- and Sipho-Medusea, (6) Physalia, (7) Valella, (17) Beroe, (16) Pleurobranchia, Cucupita, etc.

Chaetognatha.—Sagitta spp.

Annelida.—Tomopteris and some Syllids.

Arthropoda.—Copepods and other small Crustaceans, Various Larval Forms, etc.

Mollusca. — Pteropods, Heteropods, Veliger larvae.

Echinodermata. —Ophiopluteus Larvae.

Chordata. — Appendicularian and other Tunicates, Fish Eggs and Fish larvae including a Leptocephalid.

The Bombay Shore and the surrounding waters are still a virgin field for research in Marine biology. The study of some of these animals has been started in the zoology department of the Royal Institute of Science. The zoology department is being equipped for research in marine biology and offers facilities to post-graduate students and research workers.

S. H. LELE.

THE HAFFKINE INSTITUTE

This is housed in the Old Government House at Parel. The laboratory was originally started by Mr. Haffkine, the discoverer of anti-plague vaccine, on the 8th October 1896, a fortnight after plague had been officially declared to exist in Bombay. At first it was situated in a room of the Petit Laboratory at the Jamsetjee Jeejeebhoy Hospital and was known as the Plague Research Laboratory. Very soon the Laboratory was transferred to a bungalow on Malabar Hill, then to H. H. the Aga Khan's bungalow at Mazagaon and finally, in 1899, to its present commodious quarters. The original name was changed with the subsequent growth of the laboratory to Bombay Bacteriological Laboratory in 1925 and recently it was renamed the Haffkine Institute to commemorate the name of one whose labours have saved the lives of many thousands in India and elsewhere.

Anti-plague vaccine is prepared here and it was in this laboratory that the Plague Research Commission proved that the transmission of plague takes place through the agency of rat fleas and accumulated the mass of epidemiological and experimental data on which schemes for the prevention of plague are based.

The south wing of the laboratory was rebuilt and the whole building was refitted during the Directorship of Lt. Col. Glen Liston, C. I. E. In 1922 an antirabic section was formed and antirabic treatment for nearly eight thousand persons bitten by rabid animals was issued during 1932. A well equipped Pharmacological section for the study of indigenous drugs was

opened in 1923 and a few months later a Biochemical section was added. Recent researches have dealt with plague, guinea-worm, bilharziasis, anæmia, maternal mortality, and indigenous drugs, sprue, on all of which papers have been published.

The routine work of the laboratory includes the examination of 2,000 rats daily for the Health Department of the Bombay Municipality, of pathological specimens for hospitals and practitioners, of water supplies and the extraction of the venom from cobras and Russell's vipers for the preparation of antivenene.

S. SOKHEY.

THE WORK OF THE INDIAN CENTRAL COTTON COMMITTEE

The Indian Central Cotton Committee which was, in March 1921, constituted as an advisory body by the Government of India was, on passing of the Cotton Cess Act in 1923, permanently incorporated and provided with funds of its own for the improvement and development of the growing, marketing and manufacture of cotton in India.

The Committee is really a unique institution comprising representatives of all sections of the cotton industry, such as growers, gin and press-owners, traders, exporters, spinners and the agricultural departments. Its meetings provide a common platform for obtaining the views of all interests represented on it, resulting into decisions beneficial to the industry as a whole.

The Committee has been indefatigable in its efforts for promoting and maintaining by legislation the purity of Indian cotton by preventing the import, for mixing and substitution, of inferior cotton into areas growing superior strains by means of the Cotton Transport Act of 1923. The Cotton Ginning and Pressing Factories Act of 1925, which is another landmark in the achievements of the Committee, provides for the marking of bales so that adulteration and other malpractices can be traced to their source. Other Acts which have been brought into being at the instance of the Committee are the Bombay (Districts) Cotton Markets Act and the Madras Cotton Control Act, besides several other measures on which the Committee offered advice to Provincial Governments.

In the sphere of cotton research the Committee has undertaken to finance 26 research schemes in the Provinces and

States for isolating superior types of cotton, investigation into the causes of shedding of flowers, buds and bolls, for the study of the life-history of certain pests and the methods of combating them and for finding ways of overcoming the loss by wilt and root-rot. In the Bombay Presidency it has the Surat Boll-worm Clean-up Scheme, the Broach and Jalgaon Cotton Breeding Schemes, the Small Leaf Disease Survey Scheme, and the Sind Physiological Scheme. In the Madras Presidency there are the Madras Herbaceum Scheme, the scheme for breeding of Nadam cotton, the Fodder Cholam Scheme and the Pempheres and Physiological Scheme. In the Punjab, the Botanical and the Pink and Spotted Boll-worm Schemes, the White Fly and Spraying Trials schemes and the Root-Rot Schemes, are likewise in operation. Other programmes of research work include the Central Provinces Cotton Breeding Scheme, the United Provinces Entomological and Cotton Survey Schemes, the Hyderabad Botanical, Entomological and Cotton Survey Schemes, the Burma Cotton Improvement Scheme, the Bengal Comilla Cotton Scheme, the Baroda Root-Rot Scheme and the Gang Canal Scheme in Bikaner. Schemes are also in progress for wider distribution of seed of improved varieties. Thus improved Cambodia and Hagari-1 in Madras Presidency, Jayawant and Gadag No. 1 in southern part of the Bombay Presidency and Hyderabad State, 1027 A. L. F. in Gujerat and Baroda State, Banilla in Khandesh and Verum 262 in Central Provinces and Berar are being distributed. A scheme for demonstration of cotton cultivation and distribution of seed of improved varieties of cotton in Barrage areas in Sind is likewise in operation.

The Committee has taken steps to train up its own staff of techincal experts and a corps of workers. Research Scholarships have been awarded to encourage distinguished graduates to take up this kind of work.

While the necessity of research cannot be over-emphasised the importance of spreading knowledge of economic improvements effected in cotton among the varied interests concerned cannot be overlooked. It was from this point of view that after a career of a decade the Indian Central Cotton Committee decided in 1932 to start a publicity campaign which during the short

period of its existence has fully justified the hope entertained of it. While the Department of Publicity is not prevented from broadcasting information of general interest to either the cultivator, the agencies engaged in the marketing of cotton or to the manufacturers of it, it has mainly undertaken to carry on propaganda on researches that have yielded profitable results.

The Publicity Officer of the Committee is Mr. R. D. Mihra, M. A., B. Litt. (Oxon).

Technological Laboratory.— This Laboratory which was opened in the year 1924 is a valuable asset to the cotton trade in general. It possesses a complete set of the most up-to-date instruments for testing the length of staple, waste losses and the strength and evenness of fibre, and the results of these tests are invaluable to the cotton breeder in enabling him to select those strains which give the best spinning value and to discard those types which may prove of little value to the spinner. Exhaustive tests have been carried out on the variation in weights of different trade descriptions of raw cotton stored for a year in Bombay godowns, and moisture tests made from samples drawn from trade bales. Besides, the Laboratory assists the trade by undertaking spinning tests on commercial types selected by the East-India Cotton Association and on early arrivals of the principal varieties submitted by the Millowners' Associations of Bombay and Ahmedabad. In addition to these tests, a number of important matters of a technological nature concerned with the manufacture of yarn from cotton such as the application of various systems of high draft spinning to Indian cottons, the influence of different atmospheric humidities on the spinning performance of cotton have been investigated at the Laboratory of which Dr. Nazir Ahmed, M. Sc., Ph. D., is the Director.

The principal conclusions arrived at have been published in Series A, of the Technological Bulletins which deals with the processing and spinning tests of important growths of special interest to the trade, while Series B, contains the more theoretical problems relating to the fundamental properties of the cotton fibre.

The spinning Laboratory was opened on the 3rd of December 1924 by Lord Reading, late Viceroy of India, who at the same time also laid the foundation stone of the Research Laboratory.

Institute of Plant Industry.—This Institute which was established in 1924 to serve as a Central Research Institute for cotton in Central India does work which can be classified under three heads (1) a botanical survey of Indian cottons (2) selection of improved types of cotton (3) a comprehensive study of the effect of soil conditions causing stunted growth and disease and the question of preventive treatment. Special attention has been paid to the importance of eradicating weeds, the prevention of soil erosion and probably the most important success that can be claimed is an economic method for converting farm waste into high quality manure at a small cost and without disturbing established customs.

In combination with research work, propaganda is carried on extensively, State officers trained and the cultivators educated by the display of agricultural films. Simple improved instruments and pure seed are stocked and sold to cultivators of the supporting States.

Results of great practical value to the cultivators have been obtained, and further schemes for their benefit are under consideration.

Mr. F. K. Jackson, N. D. A. (Hons.). Dip. Agri. (Cantab.), is the Director of the Institute.

With a view to prevent the introduction into India of the American Cotton Boll Weevil through imported American cotton, the Government of India, at the instance of the Indian Central Cotton Committee, introduced in 1925 the fumigation at Bombay of all American cotton imported into India. The Liston Fumigating Machine is used for this purpose and steel barges loaded with American cotton and closed air tight, are kept under HCN gas for 24 hours.

P. H. RAMA REDDI.

THE NATIONAL MEDICAL COLLEGE.

The National Medical College was founded on the 4th September 1921, by a few zealous workers in the Medical and Science Professions, among whom the name of Dr. D. D. Sathaye deserves to be specially mentioned.

The object of the Founders was to diffuse the highest teaching of the progressive western medical science amongst the

youth of the country, and also to preserve and popularise the best in the Ayurvedic and Unani systems.

The government of the College was vested in a Council called the College Council, consisting of the Principal, Superintendent and the other foundation Professors.

The College was conducted in a spirit of 'non-co-operation' and was affiliated to the 'Tilak Maharashtra Vidya Peeth' of Poona upto the year 1924. From that year, it was found difficult to maintain and conduct the Institution in the same spirit, firstly because it was then realised that it would be difficult for the graduates of the College to practise Medicine & Surgery with the help of all the drugs and appliances unless their diploma was registered by the Bombay Medical Council and secondly because, it was found increasingly difficult to secure the co-operation of the best medical practitioners of Bombay for an Institution, which was non-co-operating with Government as well as with Institutions backed up or supported by Government.

As a result, there were some changes in the personnel of the Council of Management and the newly formed council decided in 1924 to get the College affiliated to the College of Physicians & Surgeons of Bombay. This affiliation was secured temporarily for two years and the same was made permanent for L. C. P. S. Examination in January 1927.

The College was also registered under the Societies Registration Act (Act XXI of 1860) in 1924 with a definite Memorandum and Articles of Association.

In 1925, Dr. A. L. Nair that well-known Philanthropist of Bombay, built and equipped a charitable Hospital in memory of his revered mother, Bai Yamunabai L. Nair and handed over the same to the Council of Management of the National Medical College to be used as a training ground for the students of the College. This act is a special land-mark in the history of this Institution as the Institution could not have existed for long without this generosity on the part of Dr. Nair.

Since the date of its birth i. e. from September 1921 to November 1927, the College was housed in a rented building

first in 2nd Victoria Cross Lane, Byculla and then in Allana Mansion on Lamington Road.

In November 1927, the present building of the College was completed and was opened by H. E. Sir Leslie Wilson, the then Governor of Bombay.

The national Medical College is dependent for its expenses on public support and is a unique example of voluntary effort and co-operative spirit on the part of many eminent medical men of this City. This feature of the Institution was described in his speech by H. E. Sir Leslie Wilson in the following words :—

"I would highly commend the independent efforts that have been made by the founders and donors of this College in building up an Institution worthy of this City without any external assistance. The National Medical College deserves the greatest credit for being the first institution of its kind in this Presidency supported entirely by voluntary contributions, not only on account of the success it has so far achieved but on account of the example it has set of what can be done by properly organised non-official effort. Such results cannot be brought about without hard work, generosity and self-sacrifice; and of all these, there is ample evidence in the history of the College."

INDUSTRIAL BOMBAY.

Bombay with a population of 1,161,383 souls is the Gateway of India and one of the finest natural harbours in the world. The harbour is large and safe. Formerly, it was cut off by the Western Ghats. But since the construction of railways across the Ghats it has become the most important port of Western India. It is the nearest port to Europe next to Karachi and chiefly exports cotton, opium, wheat and oil seeds. It is now the largest city in India. On account of its having a moist climate which is necessary for cotton spinning, it has become the chief centre of cotton manufacture. Since the middle of last century owing to excellent shipping and railway facilities and business enterprise, Bombay has dominated the cotton industry in India and still produces the greater part of the cotton goods. The pre-eminent position of Bombay City in the Indian cotton industry can be seen from the following figures :

	Bombay Island.	All India
Number of mills.	81	340
Number of spindles.	34,41,856	95,06,083
Number of looms.	76,950	1,86,341
Average number of hands employed.	1,29,534	4,03,226
Approximate quantity of cotton consumed in bales of 392 lbs.	9,20,730	29,11,264

Bombay represents 36 per cent. of the total spindles of the country and about 60 per cent. of the weaving in Bombay at present is reported to be in fancy cloths of attractive designs and finish. The mills are generally equipped with up-to-date looms, plant and machinery worked by electric power which has given an impetus to the progress of the industry on the mechanical side. The City produces about one-third of the cotton goods made in Indian mills.

The position of the industry in Bombay, as elsewhere in India, during the last two or three years has been unsatisfactory due especially to the heavy imports of cheap-priced Japanese goods.

Associated with the Cotton Industry there are some 27 separate bleaching and dyeing factories in the City and Island of Bombay, employing about 4,460 hands, 3 silk mills and 2 woollen mills employing over 2,500 hands. There are over a dozen hosiery factories in Bombay of which two are large enough to come within the operations of the Factories Act. The general economic depression together with very keen competition from imported hosiery especially from Japan has to some extent affected the progress of these establishments.

Next to the textile, the most important group of factories in the City of Bombay includes the Railway woskshops, tramways workshops, dockyards, etc., employing about 8,600 hands. In addition to this, a prominent place is occupied by works covering general engineering and shipbuilding, chemicals, coach-building and motor-car repairing, kerosene tinning

and packing, metal stamping, making of steel trunks, locks and cutlery manufacturing, oil and paper mills, soap making, etc., employing in all about 8,500 hands.

Recently, several new types of factories have come into existence in Bombay, e. g. two factories for the manufacture of vegetable ghee, a number of concerns for the manufacture of chemical and toilet products and soaps, one factory for refining and smelting of non-ferrous alloys, two factories for Bakelite materials, one for the manufacture of A. C. ceiling Fans, one for safety razor blades, one for school-boys' slates, one for the manufacture of pins and needles, one for Neon advertising signs, one for wire nails, one for the manufacture of dry cells for pocket batteries, three for fire works and two for rubber soled canvas shoes. These factories too employ an appreciable number of workers.

There has been recently a marked development in the manufacture of cutlery by machinery, such as razors, safety razors, pen-knives, etc. on a semi-large scale. The manufacture of high class surgical appliances, instruments, hospital furniture, artificial limbs, and pharmaceutical products has considerably increased.

The tanning and leather industry of the City occupies a prominent place at Dharavi in the Island of Bombay which however owing to world wide depression is not doing well.

Printing and book-binding concerns numbering about 48 employ about 4,463 hands, ice and aerated water factories, flour mills, bakeries, biscuits and confectionery factories employ about 1,200 hands.

The principal factories in the Bombay Suburban District, are the tobacco and cigarette factories and match works. The former number nine employing some 325 persons and the latter number seven employing some 4.044 workers. Other important factories in the Suburbs are the glass bangle factory at Kandivlee which employs about 400 persons, one razor factory at Andheri and one rubber soled canvas shoe factory at Jogeshwari.

The development of Hydro-Electric supply has compensated Bombay to a large extent for its disadvantageous geographical

position with respect to the coal fields of India. Cheap electric power is available in bulk to large consumers, such as, City Electric Supply Companies, large Textile and other factories and Railways for Suburban Traction etc.

The three Hydro-Electric Companies situated in the Bombay Presidency owe their development to the enterprise of Messrs. Tata Sons Ltd.

(a) The Tata Hydro-Electric Power Supply Scheme consists of three lakes—the Shirovata, the Walwhan and the Lonavla. The three lakes when full have a total lake area of 8.95 square miles and 9,541 millions cubic feet capacity on draw off level. Catchment area is 21.9 sqare miles. The power generating station is situated at Khopoli. Installed capacity of the generationg plant is 48,000 K. W., which has six generators of 8,009 K. W. coupled to water turbines of 12,000 B. H. P. and maximum head of 1,726 feet, generating at 5,000 volts. The power is transmitted to Bombay—a distance of 43 miles—by two transmission lines at a pressure of 1,00,000 volts.

(b) The Andhra Valley Power Supply Company have their water storage in the Andhra Valley with a lake area of 12.5 square miles and a 12,850 millions cubic feet capacity above draw off level. A tunnel of 86 square feet section and 8,700 feet long driven through solid trap rock carries the water to the fore bay. The generating station is situated at Bhivpuri. The installed capacity of the generating plant is 48,000 K. W. consisting of six generators of 8,000 K. W. capacity driven by 12,000 B. H. P. water turbines under a maximum gross head of 1,743 feet. Generating voltage is 5,000. Power is transmitted to Bombay over a distance of 56 miles by two transmission lines at a pressure of 1,00,000 volts.

(c) The third Hydro-Electric Scheme is the Nila-Mula Scheme. The dam which is situated at the junction of the two rivers—the Nila and the Mula—closes a catchment area of 95.6 square miles and a lake area of 14.85 square miles with 16,120 millions cubic feet capacity above draw off level. The lake area is connected with the power station fore bay by a tunnel 140 square feet section and 14,850 feet long. The power station

is at Bhira with an installed capacity of 87,500 K. W. consisting of five generators of 17,500 K. W. capacity coupled to water turbines of 26,000 B. H. P. under a maximum head of 1,650 feet; generating voltage is 11,000. Power is transmitted to Bombay over a distance of 76 miles by two transmission lines at a pressure of 1,10,000 volts.

The advent of the Hydro-Electric Companies has made it possible for the supply of comparatively cheap bulk power to the cotton mills and other industries, the electric supply companies for city lighting and small industries, and Railway for suburban traction etc. There is sufficient water storage capacity to allow for extensions to the generating plant to meet the present and future requirements of Bombay City, its suburbs and the towns and areas through which the transmission lines now run.

The principal educational institutions of industrial interest are the Sir J. J. School of Art, Bombay, and the Victoria Jubilee Technical Institute, Matunga, Bombay.

The School of Art has special workshops devoted to the instruction of craftsmen with a view to turn out skilled men Cabinet making, Engraving and Enamelling, Gold and Silver Copper and Brass and Repousse Beating, House Painting and Decoration, Iron Work, Stone and Wood Carving, etc. are chiefly taught.

The Victoria Jubilee Technical Institute, Matunga, Bombay is the premier technical institute in the Bombay Presidency and is in a class by itself. Regular courses of instruction covering a period of 4 years are given in (a) Mechanical Engineering, (b) Electrical Engineering, (c) Textile Manufacture (d) Technical and Applied Chemistry, and (e) Sanitary Engineering and Plumbing. Candidates from different parts of India apply for admission and the applications far exceed the number which can be admitted. In addition to the regular courses mentioned above, Apprentice Classes are held once a week in Elementary Mechanical and Electrical Engineering, Cotton Spinning and Weaving, and Electric Wiremen's Class I and II. Eleven special scholarships of Rs.35 each per month are awarded by the Director of Industries to

enable students from the *Intermediate* Hindus and Mahomedans and *Backward Classes* to acquire instruction in this Institute.

The latest development in the direction of higher technical education is the decision of the University of Bombay to establish a Department of Chemical Technology for post-graduate instruction in Textile Chemistry and Chemical Engineering. The Institute will be located in the East Wing of the Royal Institute of Science and it is expected that it will start its regular work in June 1934.

P. B. ADVANI.

WATER SUPPLY OF BOMBAY.

Prior to 1860, Bombay derived its supply of water from wells and tanks which were extremely liable to pollution from insanitary surroundings. The city today has four impounding reservoirs or lakes, viz. (1) Vehar, (2) Tulsi, (3) Powai and (4) Tansa. These are formed by bunding up valleys to impound monsoon water. The consumption of water in the City to-day amounts to about 90 million gallons per day out of which 75 million gallons are drawn from Tansa and about 15 million gallons from Vehar. The following table will give an idea of the growth of the city and its water supply since the year 1861.

Item.	1861 Vehar Water introduced in 1860	1879 Tulsi water introduced.	1892 Tansa water introduced.	1916-17 Tansa supply duplicated.	1922-23 Tansa Completion scheme in progress.	1932 After termination of Tansa Completion Works.
1. Population.	7,00,000	7,45,000	8,30,000	10,00,000	11,95,568	11,61,383
2. Number of connections from Municipal mains.	1,061	12,030	18,113	25,542	28,704	35,789
3. Supply in million gallons per day.	7	10.5	31.5	46	48	86
4. Supply in gallons per head per day.	10	14	38	46	49	74
5. Income from water supply.	Rs.45619	3,54,798	11,81,429	24,71,834	48,48,252	63,97,023

To-day there are about 36000 house connections out of which about 2000 are metered. The daily average of the metered connections is about 15.10 million gallons including 2.30 million gallons supplied to the suburbs of Bandra, Kurla etc. About 7 million gallons per day are used for municipal purposes such as street watering, road washing, gully flushing, public fountains, gardens etc.

The total capital expenditure incurred on the water works of the city amounts to about Rs. 9½ crores as under:—

(1) Vehar Water Works	Rs.	70 lakhs
(2) Tulsi Water Works	„	40 lakhs.
(3) Powai „	„	12 lakhs.
(4) Bhandarwada Reservoir works	„	13 lakhs,
(5) Malabar Hill Reservoir Works	„	16 lakhs;
(6) Original Tansa Works	„	150 lakhs.
(7) Tansa Duplication	„	70 lakhs.
(8) Tansa Triplication	„	505 lakhs.
(9) Distribution and service mains and other miscellaneous works in the city	„	75 lakhs.
	Rs.	951 lakhs or say Rs. 9½ Crores.

Against the above expenditure of 9½ Crores the total debt on water works stands today at about Rs. 7.85 Crores. The cost of maintenance including interest and Sinking fund charges amounts this day to about 67 lakhs as detailed below;—

Maintenance charges	Rs.	8·7 lakhs.
General Supervision	„	2·3 „
Interest on loans	„	39·5 „
Equated payments	„	7·5 „
Sinking Fund	„	8·8 „
	Rs.	66·8 lakhs or say Rs. 67 lakhs.

The average cost of water per 1000 gallons based on the supply delivered into the City and suburbs during the last 12 years including interest and repayment of loan charges as well as annual sinking fund necessary for the renewal of unserviceable mains works out to about 7 as. per 1000 gallons.

(1) *Vehar Lake*—As pointed out above, this was the first lake to be constructed for the purpose of introducing a piped water supply into the City. Its construction was undertaken by Government in the year 1855 and it was completed early in 1860 at a cost of about Rs. 65½ lakhs of which Rs. 20 lakhs were contributed by Government and the balance of 45½ lakhs is being repaid by the Municipality to Government by equal annual instalments. It was transferred to the Municipality in the year 1863 on 99 years lease. It is located to the north of the City at a distance of about 15 miles and its altitude is about 130 ft. above the Bombay Town Hall Datum. It is formed by bunding up the Vehar river with three earthen dams. The highest dam is 84 ft. in height and 850 ft. long. The lake has a catchment area of 6 sq. miles with a water spread, when full, of 2¼ sq. miles. All privately owned agricultural lands to the extent of 1000 acres lying in the catchment area were acquired by the Municipality at a cost of about Rs. 4 lakhs about the year 1923 as a precautionary sanitary measure. The capacity of the lake was increased to about 9120 million gallons in the year 1886 by raising its full supply level by another 3 ft. at a cost of about Rs. 25 lakhs which included the cost of incidental works. The average useful depth of the lake is 30 ft. The average annual rainfall works out to about 82 inches and the minimum and maximum falls recorded during the past 71 years being 35 inches and 130 inches respectively. The lake, when full, is capable of supplying about 16 million gallons per day and its capacity in normal years of rainfall may be taken at about 10 million gallons per day. The waste weir is 600 ft. long. The water from the lake is conveyed to the city by means of a 48″ pipe line which is mostly of cast iron excepting for a small length of about 3 miles which is of steel. The 48″ pipe line crosses the 72″ new Tansa main near Powai and runs along the 60″ Tansa branch main for about a mile. The 48″ Vehar and 60″ Tansa are connected by a cross connection. A 24″ branch connection is taken off the 48″ main at a point in the 5th mile of Vehar–Sakie road. This 24″ branch connection runs through old Kurla village and enters the City via Sion, Matunga, Wadala, Bhoiwada, Govt. Gate Road and Lalbaug. The 48″ pipe is tapped by a 32″

main before it enters the City. The latter runs along Vincent Road, Suparibaug Road, Currey Road.

The Vehar mains supply directly the major portion of F Ward and certain parts of G and E Wards.

The water of this lake contains algae and favours the growth of shell-fish. It is infested with crocodiles. In the past, the water of this lake used to be passed through slow sand filters located at the Bhandarwada Reservoir before it was delivered for consumption. These filters have been absorbed in the reservoir at Bhandarwada and the water is not now filtered but is chlorinated at the lake before it is admitted into the outlet mains. The dose of chlorine varies from 0·4 to 0·8 parts per million in accordance with the quantity of water available for supply during the different seasons.

The average daily loss of water on account of evaporation, absorption and leakage during the dry months may be taken as 5 to 6 million gallons.

(2) *Tulsi Lake.*— This lake was constructed at a cost of Rs. 40 lakhs in the year 1872 as the supply from Vehar was found to be inadequate to meet the then demands of the City. It is situated at a distance of about three miles to the north-west of the Vehar Lake. It is formed by throwing two dams across the Tulsi nala. The main dam is of masonry and is 1360 ft. long and 85 ft. high. The second dam is of earth. The waste weir is 142 ft. in length. The overflow from this lake runs into the Vehar Watershed. The total catchment area of the lake is about 1669 acres including a water spread, when full, of 331 acres. The lake has an average depth of 50 ft. Its storage capacity is 2294 million gallons. Its altitude is 300 ft. above the Bombay Town Hall Datum. The average annual rainfall is 99″ and the minimum and maximum falls recorded being 45″ and 150″ respectively. The whole catchment area of this lake has been acquired by the Municipality which has been converted into a forest and handed over to the Forest Department for maintenance. The temperature of water in the lake varies from 72° to 90° F. The capacity of the lake, when full, may be taken as to 3 to 4 million gallons per day. This lake is connected with the Malabar Hill Reservoir by a 24″ C.I.

pipe which runs through Vehar catchment and meets the 57" steel Tansa Pipe lines at Morol and follows their route through Morol, Santa Cruz upto Bandra. It then leaves the alignment of 57" Tansa mains and follows the B. B. & C. I. Railway lines and passes along Haines Road, Clerk Road, Pedder Road to the Malabar Hill Reservior.

The water of this lake contains more algae and vegetable matter than Vehar water. Before the introduction of Tansa Supply it used to be filtered in slow-sand filters situated at the Malabar Hill Reservoir before admission into the supply mains of the city. The slow-sand filters at Malabar Hill reservoir having been abolished, seven mechanical filters were constructed in the year 1927 for filtering this water at a cost of Rs. 4 lakhs. These filters are located near Powai. A chlorinating plant has been provided in conjunction with these filters to chlorinate the supply before its admission into the 24" main. Since the termination of the Tansa Completion Works this lake is not being drawn upon but has been kept as a stand-by in case of emergencies. The average daily losses by absorption, evaporation and leakage in the dry weather are about to 2 million gallons.

(3) *Powai Lake.*—This lake was constructed in the year 1889 at a cost of Rs. 6 lakhs as an emergency supply to meet an anticipated water famine in the year 1890 due to the non-completion of the first stage of the Tansa Water Works prior to that year. This lake is situated in the close proximity and to the south of Vehar Lake. It is formed by constructing a masonry dam 150 ft. long and 35 ft. in height. Its altitude is 60 ft. below the level of Vehar Lake, i. e. about 60 ft. above the Bombay Town Hall Datum. A pumping plant had therefore to be provided to pump the water of this lake either into the Vehar Lake or into the pipe line conveying water from Vehar Lake. Its catchment area is 1650 acres and its water-spread, when full, is about 550 acres. The behaviour of rainfall at this lake is similar to that of the Vehar catchment. The catchment area of the lake has not been acquired by the Municipality except the 550 acres forming the water-spread of the lake when full.

The water of the lake was found to be unpotable and the

elevation of the lake being not suitable to obtain a gravity supply to the city, it has not been used since 1892.

It was proposed in the year 1919 to supply water from this lake after treatment in open gravity mechanical filters to the Development Department for the use of the suburbs. The Development Department were to lay their own mains from a service reservoir to be constructed by them at their cost in the vicinity of the filters. The capacity of the lake was also to be increased from 2 to 3 million gallons per day, by another 5 ft. The Municipality carried out the work on the raising of the dam and the filters at a cost of about Rs. 6 lakhs. The scheme of supplying water to the suburbs fell through as the Development Department were ultimately allowed to tap the Municipal trunk mains at convenient points for the water supply of the suburbs. The Municipality has entered into an agreement with the Development Department to supply water to the suburbs to the extent of 2·70 million gallons per day for a period of five years. The lake is not used for the supply of the City, but is kept as an emergency supply.

(4) *Tansa Lake.*—This lake is the major source of supply to the City. Great foresight was shown in its design to withstand expansion at reasonable cost. The lake as it stands today has been built in three stages. The first stage was completed in 1892 at a cost of Rs. 1½ crore to obtain a supply of 21 million gallons per day. In order to increase the available supply from the lake from 21 to 40 million gallons per day, the dam was raised to a height of 8½ ft. with the incidental works about the year 1915 at a cost of Rs. 70 lakhs. This formed the second stage of the scheme. In 1921, the dam was raised to its pre-designed ultimate height. Two additional pipe lines of rivetted steel 72″ in diameter and 40 miles in length along with the 57″ pipe as their extensions 12 miles in length were laid about the year 1927 to enable a total supply of 90 million gallons per day being brought into the City. The cost of the works executed under the third stage of the scheme amounted to about Rs. 5 crores. Tansa lake is situated at the foot of the Western Ghats. Its dam is at a distance of 8 miles from the Atgoor station on the G. I. P. Railway (N. E. line) and 55 miles north-east of Bombay. It has a catchment area

of 53 sq. miles which includes $7\frac{1}{2}$ sq. miles of water-spread when the lake is full. The full supply level of the lake is at an altitude of 320 ft. above the Bombay Town Hall Datum. It has been formed by constructing a masonry dam of rubble in hydraulic lime mortar across the Tansa river. The dam is 9800 ft. in length and 135 ft. in height in the deepest portion. The waste weir is constructed to the south of the dam and is 200 ft. in length. The greatest flood discharge recorded over the waste weir was 3.15 ft. in the first stage of the scheme and it amounted to a flow of 13 million gallons per minute.

The present storage capacity of Tansa lake is 35604 million gallons. The losses by evaporation and absorption per annum amount to about 7000 million. About 6000 million gallons are not available for draw-off as they are not at a sufficiently high altitude to gravitate through the Tansa main to the City at the required rate of discharge. The available supply from Tansa may therefore be taken at about 23000 million gallons which is equivalent to a storage of about 8 to 9 months and 12 months with rates of supply of 90 and 75 million gallons per day respectively. It is usual in the case of reservoirs intended for City water supplies to make them large enough to hold at least storage to meet the demands of the City in three consecutive dry years. The storage capacity of Tansa being only equal to a year's supply at the rate of 75 million gallons per day, its yield per day from year to year will be a variable quantity. If the rainfall is good and the lake remains filled to its full supply level on 1st of November a daily supply of 90 million gallons can be drawn up to the 15th of July of the following year without allowing the level of water in the lake to go below R. L. 390 on the latter date. If on the other hand the level of water in the lake on 1st Nov. remains at 414·75 i. e. 5′ 3″ below the full supply level a daily supply of 75 million gallons per day can be drawn up to the 15th of July of the following year without allowing the level of water in the lake to sink below R. L. 387·00 on the latter date. The average annual rainfall at the dam is 94″ and the maximum and minimum recorded falls are 40″ and 133″ respectively. The yield from the catchment in the driest year in 1899 was about 12000 million gallons only. In order to maintain a supply of 75 million gallons per day the replenishment from the catchment is

required to be at least 35000 million gallons per year. This yield is equivalent to a run off of 47 which may be taken to correspond approximately to an average of about 80 inches of evenly distributed rainfall over the catchment. The study of the rainfall statistics at Tansa dam indicates that had the dam been constructed to its present height from the very commencement it could have been possible to draw a supply of 90 million gallons per day during the dry weather period following the monsoon of 1916, 1917, 1921, 1931, 1932 and 1933 and a supply of less than 70 million gallons per day during the dry weather period following the monsoon of 1899, 1904, 1905, 1906, 1911, 1918 and 1929. The rainfalls of 1899 and 1905 would not have given a supply of even 50 million gallons per day. With a draw off of 75 million gallons per day during the preceding years the supply available during the years 1899, 1904, 1905, 1906, 1918, 1920 and 1929 would have been 16, 40, 30, 60, 61, 60 and 60 million gallons per day respectively. With a draw off of 90 million gallons per day in the previous year the supply available with a rainfall similar to that of 1899 would be only one million gallon per day during the dry weather period following the monsoon and up to the 15th July of the following year. It will be apparent from the above that the supply available from Tansa is a variable quantity depending upon the rainfall of the year. In good years Tansa can be depended upon to give a supply of 90 million gallons. The safe yield of Tansa with a constant rate of supply even in years of scanty rainfall may be taken between 45 and 50 million gallons per day.

The water obtained from Tansa lake is of a very good quality both from bacteriological and chemical points of view, though the few villages in its catchment are not acquired. Most of the villages are situated near the boundary of the water-shed and therefore at a considerable distance from the margin of the lake. The scheme of acquiring these villages has been held in abeyance for the present for want of funds. Tansa water is subjected to chlorination before it enters the city. There are two installations for chlorinating the supply. The one located at Bhandup is of the gravity-feed type and the other located at Powai is of the pressure type. In the former, chlorine solution of predetermined strength is gravitated into the Tansa pipe lines. In the

case of the latter, ebonite-lined pumps have been installed for injecting the chlorine solution into the pipe lines. The gravity-feed plant has been in use for the past seven years and the pressure-type plant has been kept as a stand-by. Liquid chlorine to the extent of about 230,000 lbs. per year is used for chlorinating the waters of Tansa and Vehar Lakes. The dose varies from 0·4 to 0·8 parts per million. The total expenditure on chlorination amounts to about Rs. 1 lakh per annum.

Water from the lake is conveyed to the City through (1) a conduit 55 miles in length which consists of a duct, tunnels and seven syphons and (2) by means of two independent rivetted steel pipes. The total carrying capacity of the duct and the two pipe lines is about 130 million gallons per day. At present, the duct is not in use but the two steel pipes are used for delivering the water into the city. Their carrying capacity is about 90 million gallons per day. The duct was constructed in the first stage of the scheme. It has a carrying capacity of 40 million gallons per day. But the seven syphons constructed in the first stage had a carrying capacity of 18 to 20 million gallons per day, as they then consisted of a single pipe line only. The carrying capacity of the syphons was increased to about to 36 million gallons per day in 1915 by duplicating the pipes. The pipes used in the syphons are of two kinds, C. I. pipes 48″ in diam. and 50″ diam. lockbar steel pipes. The total length of the duct is about 22 miles and that of the tunnels about 4¼ miles. The two independent steel pipes mentioned above were laid between the years 1921 to 1927. They do not follow the same route as the old duct line. They are laid along a shorter route. They are 72″ in diameter upto Powai, a distance of 40 miles from Tansa. They are reduced to 57″ at Powai and are continued up to Nana's Chowk near Grant Road Ry. Station. A 60″ steel pipe cross connection is made just near Powai to connect with the Ghatkoper syphon. This connection is about 3 miles in length. The steel pipes have been interconnected at suitable points with mains from Vehar and Tulsi. The water from Tansa is delivered into the two service reservoirs at Bhandarwada and Malabar Hill. A trolly line has been provided along the route of the pipe lines upto Bandra to facilitate inspection and maintenance.

Distribution.— Some parts of the city are supplied directly from the supply mains while others are supplied through the

service reservoirs at Malabar Hill and Bhandarwada. The following table gives particulars as to their capacities, altitude etc.

Description.	Malabar Hill Reservoir with compartments.			Bhandarwada Reservoir with compartments.		
	I	II	Tower Tank.	I	II	III
Height of floor level above Town Hall Datum in feet	137	137	207	75	60	84
Height of full supply level above Town Hall Datum in feet.	154	157	217	90	90	94
Contents in M. G.	14·8	15·4	·4	6·6	7·5	5·9
Total Capacity.	30 M. G.			20 M. G.		
Total area of Garden.	6½ Acres.			5¾ Acres.		

There are seven supply mains entering the City from the lakes in the north. Four from Tansa, two from Vehar and one from Tulsi. The area north of Lalbag, Jacob Circle and Nana's Chowk are supplied directly by the Tulsi, Vehar and two of the Tansa mains. They include the whole of F and G Wards and a portion of D and E Wards. The areas served by the Bhandarwada reservoir comprise of a portion of E ward and the whole of B ward. The Malabar Hill reservoir serves the remaining portion of C, D and E Wards and the whole of A Ward.

The supply given is constant on the ground floor but in-ermittent in respect of the upper floors. The usual hours of supply for different wards are as under :–

A ward–24 hours, full pressure which varies from 45 to 70 lbs. per sq. inch.

B, C, D & E Wards	4 A. M. to 11 A. M.		full pressure,
	11 „ to 4 P. M.		16 lbs.
	4 „ to 9 „	full pressure and	
	9 „ to 4 A. M.	12 to 15 lbs pressure.	

The total hours of full pressure amount to 7 in the morning and 5 in the evening.

F & G Wards–Constant. The supply is available for 24 hours as it is directly given from the supply mains.

The draw off at the time of peak loads is as much as 2½ times the average. The distribution system is being improved from time to time to mitigate the hardship caused to the occupants of top floors during the peak load periods. The total supply given directly from the mains amounts to about 45 million gallons per day and that from Bhandarwada and Malabar Hill Reservoirs approximates 30 and 15 million gallons per day respectively. The whole supply to the city is delivered by gravity with the exception of a quarter of a million gallons which has to be pumped from the Serna Reservoir at Malabar Hill to an overhead storage tank about 50 feet in hignt, for distribution to the high level areas at Khambala Hill and Ridge Road.

The Total mileage of pipes outside the City is 180 and their sizes vary from 24″ to 72″. The total length of municipal mains of sizes more than 3″ in deir. in the City amounts to about 320 miles. The number of the fire hydrants provided on the mains for fire protection is about 6000. There are about 170 public drinking fountanis in the City for the gratuitous use of the inhabitants.

N. V. MODAK.

CITY OF BOMBAY IMPROVEMENT TRUST

Memories are short and it requires an effort to reconstitute the Bombay of 1898 when the Improvement Trust was first created. Some of the younger people may not have known Bombay as it was before the Trust was created.

At that time Bombay was a plague-stricken City and almost every year there used to be an outbreak of plague causing a loss of many valuable lives.

In the early part of 1897, consequent on the outbreak of plague, the Government of Bombay took into their serious consideration the question of a comprehensive Scheme for the improvement of the City of Bombay, more especially in respect to the better ventilation of the densely inhabited parts the removal of insanitary dwellings, and the prevention of overcrowding.

In September 1897, the Government of Bombay after conducting preliminary inquiries and considering the best agency to be entrusted with the task and discussing the intricate financial questions involved, which occupied several months, placed before the Corporation and other bodies interested, the outline of a proposal for dealing with the question on a comprehensive plan. This included the constitution of a Special City Improvement Trust, following closely the lines on which the Port Trust was formed. This Trust partly representative and partly nominated was to be endowed on favourable terms with the use of valuable Govt. and Municipal lands and was to be subsidized from Municipal revenues and was to be entrusted with the work of making new streets, opening out crowded localities, constructing sanitary dwellings for the poor and for the City Police and reclaiming lands from the sea to provide for the expansion of the City.

The Scheme as thus outlined was approved of unanimously by the Committee of the Chamber of Commerce and the Port Trustees and by a large majority of the Municipal Corporation.

A Bill to give effect to the proposal was introduced in the Legislative Council on 29th January 1898 and was before the Council until 2nd April when after undergoing considerable alteration in points of detail, it was read a third time and passed.

The assent of the Governor-General of India thereto was published on 30th August 1898 and subsequently by notification, the 9th November 1898 was fixed as the date from which the term of office of the first nominated and elected Trustees should commence.

The Trust has carried out several very useful Schemes and has opened out some of the worst slums of Bombay. It had made roads and laid out plots for healthy, saintary and im-

posing buildings, has quarried away hills to promote free flow of air and has filled up several low lying areas which used to remain covered with water during a considerable time in each year.

It is only those who had seen Bombay as it was before 1898 and see Bombay as it is now who can appreciate the good work which has been carried out by the Trust. When the Trust was first created there was no Cuffe Parade, no builings between Colaba Causeway and the Secretariat and practically none between Hornby Road and Waudby Road, the area through which Princess Street now passes was covered by some of the worst slums in Bombay, rice and pommelos were grown on what is now known as Gamdevi Estate (Hughes Road), New Queen's Road, Lamington Road and Sandhurst Road did not exist, the Agripadas (West, Central and East) consisted for the main part of low lying land covered with water during and for a considerable time after each monsoon, practically the whole of the east of the Island from Lalbaug northwards was under cultivation of rice and other crops and the notoriously unhealthy areas known as Kolbhatwadi, Mandvi Koliwada, Memonwada, Nowroji Hill, 1st Nagpada, Guzar and Tulsi-rampada were the breeding places of plague and other diseases. At that time there was no broad central road from south to north and one had to go from south to north by narrow tortuous roads instead of the present Mahomedali Road and the Parel Road.

The Trust's activities might in facts and figures be analysed as follows:—

The Trust has—

(a) Acquired 2,449 acres of land at a cost of about Rs. 9,44,66,000.

(b) Demolished 33,693 tenements practically all of which were congested and insanitary.

(c) Filled in about 1,332 acres of low lying lands, utilizing for the purpose about 22·40 lakhs brass of earth.

(d) Constructed 60·9 miles of roads (varying in width from 20 to 120 ft.) at a cost of Rs. 230 lakhs.

(e) Constructed 10,074 rooms including shops and godowns at a cost of Rs. 148·27 lakhs inclusive of cost of land valued at Rs. 30·20 lakhs.

(f) Disposed of 24·16 lakhs sq. yds. of land valued at Rs. 631·78 lakhs on which 19,300 residential tenements in addition to numerous shops, factories, milch cattle stables (for over 4,725 animals) and other buildings have been erected.

(g) Built for housing the Bombay City Police 3,476 tenements at a cost of Rs. 110·49 lakhs yielding a revenue of Rs. 6·71 lakhs.

(h) Provided 13,91,600 sq. yds. of land reserved as playgrounds.

(i) Planted over 11,700 flowering and other trees.

(j) Quarried about 5 lakhs *brass* of solid rock.

(k) Constructed or acquired land for the construction of 1,244 rooms used as Mill Company's Chawls.

The Trust was during the first few years working at a small profit and was in the year 1910–1911 able to distribute Rs. 18,28,764 of its profits to the Bombay Municipality (Rs. 17,28,621) and Government (Rs. 1,00143). The annual profits which were below Rs. 5 lakhs upto the year 1912–1913 rose to about 7½ laks during the next 3 years and during the next five years steadily rose till they reached the figure of over Rs. 22 lakhs in the years 1919–20 and 1920–21.

Unfortunately during the boom period when the price of land was very high, the Trust launched huge Schemes in the north of the Island as a result of which the Trust has acquired vast areas of land for which there does not seem to be any great demand. The Trust has spent about 6 crores of rupees for Acquisition and Works in the following Schemes :—

(1) Worli, Scheme 52.
(2) Dharavi, Scheme 56.
(3) Sewri-Wadala, Scheme 57.
(4) Worli Extension, Scheme 58.
(5) Sewri Koliwada, Scheme 59.
(6) Naigaum, Scheme 60.
(7) Fergusson Road, Scheme 61.

If further, interest on the amount spent is taken into consideration, it would be found that the annual loss which the Trust makes on these Schemes would come to about Rs. 50 lakhs per year.

At the time when these schemes were taken in hand, Bombay was expanding very rapidly and it was considered necessary to provide more space for the rapidly expanding City. At that time, the Government of Bombay, the Bombay Port Trust and the Bombay Municipal Corporation also undertook various Schemes for the expansion and development of " Greater Bombay ".

Bombay is now a very much healthier and cleaner City and the credit for this is due not only to the Improvement Trust but also to the activities of the Health Department of the Bombay Municipality and of the Port Trust. The mortality of the City of Bombay which was 58 per thousand in the year 1897 has come down to 21 per thousand in the year 1930. For the Trust chawls and semi-permanent sheds the mortality which in the year 1912 was 36·33 per thousand gradually and steadily came down to 7.12 per thousand in the year 1924.

There can be no two opinions about the beneficial activities of the Trust and of the great improvement in the conditions of life in the City of Bombay, brought about by these activities. The Trust is also responsible for introducing the 63½ degree rule for light and air planes and for some of the finest buildings in Bombay. All these advantages would have accrued to the City without the heavy burden of losses and deficits which are due not to these beneficial activities of the Trust but to the launching of huge schemes and the acquisition of vast areas in the north of the Island, which are practically all lying vacant and unoccupied. This is entirely the result of the world wide economic depression which has been felt much in a large City like Bombay where there are several special circumstances to intensify the effect.

Owing to increasing annual deficits which reached the enormous figure of about Rs. 34 lakhs in the year 1931-32 it became impossible to carry on the activities of the Trust without additional sources of revenue.

The Duty on tobacco has been quadrupled and is estimated to give ultimately an additional revenue of Rs. 12 lakhs per year. The Bombay Municipality also agreed to increase its contribution from 2% to 3% of the General Tax which is expected to give an additional revenue of about Rs 11½ lakhs. Government have further agreed to impose a tax on Passengers and give the proceeds to the Corporation to enable them to shoulder the burden devolving upon them by the amalgamation of the Improvement Trust with the Bombay Municipality. The Trust has been dissolved and merged in the Bombay Municipality from 1st October 1933.

H. B. SHIVADASANI.

BOMBAY PORT TRUST.

Administration.—The affairs of the Port of Bombay are under the supervision and control of the Bombay Port Trust, a corporate body created by an Act of Legislature, consisting of a whole-time Chairman appointed by Government and twenty-one members of whom eight are nominated by Government including one representative of Labour, five by the Bombay Chamber of Commerce, five by the Indian Merchants' Chamber, two by the Municipal Corporation of the City of Bombay and one by the Bombay Millowners' Association. The whole of the administration of the harbour, lighting, pilotage, docks, bunders, railway, and landed estate is carried out under this Board.

The Board had its origin in 1862 in a private concern called the Elphinstone Land & Press Co.; this Company entered into a contract with Government to provide a hundred acres for the terminus of the Great Indian Peninsula Railway, receiving in return the right to reclaim from the sea for its own properties. Developments of the port immediately followed, but Government, seeing the inadvisability of vesting such a monopoly of the harbour front in a private Company, decided to buy it out and transfer its properties to the charge of a public trust. In 1869, therefore, rights of the Company were taken over by Government and finally vested in a newly created Port Trust in June 1873. In 1879 the Trust was reconstituted by a fresh Act of Legislature on a basis which has remained practically unchanged to the present date.

The Harbour.—The port of Bombay, a deep arm of the sea between the Island of Bombay and the mainland, owes its importance to its geographical position and to its magnificent natural deep water harbour. Its central position and accessibility by sea and land have made Bombay the main gateway and distributing entrepot for the overseas trade of Western and Central India.

The harbour, which is one of the safest and most spacious in the world, covers some 74 square miles and provides secure and ample shelter for shipping at all seasons of the year, being about 14 miles long, 4 to 6 miles wide, with a general depth varying from 22 to 40 ft. The entrance to the harbour is from the south-west; and the Colaba peninsula, the narrow strip of land which constitutes the southern extremity of Bombay Island, forms a natural breakwater affording protection from the violence of the monsoon. The extreme range of tide is 18 ft. 7 in. and the range between low and high spring tides is 12 ft.

The port and its approaches are excellently lighted. The three principal entrance lights are Prongs Lighthouse to the North, Kennery Lighthouse to the south and the unattended floating Light Vessel. Kennery Lighthouse is situated on the island of that name, which is about 11 miles south of Bombay and is about 154 ft. above sea level and visible for 18 miles. Prongs Lighthouse which marks a reef running south from Colaba Point. is 146 ft. high and visible for 17 miles. The Light Vessel exhibits the white group flashing light from a mast-head 32 ft. above the water and is visible for 11 miles. Prongs and Kennery Lighthouses are connected by wireless telephone with the Pilot Vessel and the Port Signal Station situated on the tower of Ballard Pier.

As a further aid to vessels making the port there is a fixed Wireless Beacon on Kennery Island which has a maximum range of 100 miles and there is also the Direction Finding Station at Juhu some sixteen miles on the coast north of Bombay, from which accurate bearings may be obtained.

On the Port Signal Station, storm warnings received from the Meteorological Office at Poona by telegraph are hoisted by day and night immediately on their receipt.

Pilotage is compulsory in Bombay for vessles exceeding 100 tons.

The Wet and dry Docks. There are three enclosed Wet Docks and two Dry Docks particulars of which are as follows:-

Name & date of completion	Width of entrance	Depth on sill at H.W.O.S.T.	water area.	Lineal feet quayage	Number of berths (including harbour walls)
	ft.	ft.	ft.	ft.	
Prince's Dock (1880)	66	28	30 acres	6,910	14
Victoria Dock (1888)	80	30	25	7,805	16
Alexandra Dock (1914)	100	41 (on outer sill) 37 (on inner sill)	49½	16,055	20 (plus 3 berths for ferry steamers

Name & date of completion	Width	Length	Depth
Merewether (1891)	65 ft.	525 ft.	26′-6″ on sill at M.H.W.
Hughes (1914)	100 ft.	1000 ft.	34′-6″ —do— —do—

Hughes Dry Dock is divided in the centre so that it can be used, if required, as two docks.

Between four and five million tons of cargo are handled annually over the dock quays. Every berth in the docks, except two which are reserved as open berths for certain classes of bulk cargo, has its own enclosed transit shed, fully equipped with hydraulic cranes and hoists; shoots for discharge of bag cargo. lock-up pinjras for valuable goods etc., the total floor area of the sheds being approximately 2,500,000 sq. ft.

All the sheds in Alexandra Dock have rail sidings both on the quay front and at the rear, with large sorting yards on either side of the dock; the majority of the berths in the older

Docks are also rail-served. The total number of movable hydraulic cranes of various capacities in all three Docks is 209 the two older docks being equipped with 30 cwt. cranes and Alexandra Dock with 35 cwt. of the luffing type with a 38 ft. rake from the quay wall. There are also a number of five and six ton quay cranes, two fixed cranes of 30 tons and 100 tons and a 60 ton floating crane, in addition to several portable runabout cranes of varying capacity.

All berths in Alexandra Dock are provided with oil bunkering service pipes connecting with the liquid fuel installations and special berths are set aside at the Harbour Walls for the discharge of bulk fuel oil, kerosene, and lubricating oils. Bunkering and discharge can be carried out simultaneously as the service pipes have been duplicated. A specially equipped barge is provided for the reception of oil waste and bilge refuse.

In addition to the transit sheds each dock has an extensive range of warehouses fronting on the main roads behind the docks and being also rail-served, goods can be loaded direct into railway wagons. The total floor area is approximately one million square feet. The largest type are three-storeyed and a certain number known as 'protected' are reserved for the storage of special classes of cargo, chiefly piece-goods.

In close proximity and centrally situated is the Fire Brigade Station constructed and equipped specially to deal with fires in the docks.

The trans-oceanic passenger traffic of the Port is mostly dealt with at Ballard Pier, an extension of the Alexandra Dock Harbour Wall for a distance of 1500 ft. Immediately fronting the berth is a handsome two-storeyed building divided internally into a Central Reception Hall, a Customs Examination Hall and Railway Concourse, which links the adjoining railway station. The upper floor is occupied by the Foreign Mail sorting office of the Postal Department, a restaurant and retiring rooms for passengers.

The railway station adjoining the Pier has four covered

platforms from which special through trains run to Calcutta, Delhi, Peshawar and most of the principal centres of India.

There is a supplementary passenger and trooping berth at No. 18 Alexandra Dock Harbour Wall. The coasting passenger services are provided special berths at Prince's and Victoria Dock Harbour Walls and the Ferry steamer services have six berths at the north end of the Alexandra Dock Wall fully equipped with examination sheds, refreshment shops and waiting rooms.

The total number of overseas passengers embarking and disembarking exceed a hundred thousand annually, and the total number carried by the coasting and ferry steamers is over a million.

The handling of the foreign mail at Ballard Pier is an expeditious and interesting operation. Immediately the ship makes fast alongside, hydraulic cranes discharge the mail bags, averaging about 5000 to 6000 in number, on to the quay whence they are raised by electrical elevators to the Foreign Mail Office where they are sorted for despatch to all parts of India and Burmah.

The Bunders. Besides the enclosed docks, there are situated along the harbour front a number of " Bunders " or open wharves and basins where the traffic carried by coasting and country craft and the " overside " cargo from the docks and the stream is handled. These bunders which comprise an aggregate quayage of 30,000 lineal feet, are equipped with cranes, sheds and other facilities for loading, unloading and storing cargo. In normal years over a million and a quarter tons of cargo, or roughly one fifth of the total tonnage of the port, are handled annually on the bunder wharves. The extensive Timber Ponds at Sewri, covering an area of over 60 acres, form a prominent feature of the bunders.

The Railway. The Port Trust Railway handles nearly 50 per cent. of the rail-borne goods traffic of Bombay. The principal traffic commodities are cotton, grain, seeds, oil-cakes, manganese ore, sugar. kerosene and other bulk oils, coal, charcoal and China clay. Though only 7½ miles in actual length, it comprises

nearly 120 miles of main lines and sidings which are divided into five sections, all directly linked with the docks and wharves:—(1) the receiving and despatching yard at Wadala, where the link with the trunk railways is formed, (2) the bulk oil depots, (3) the Mazagon-Sewri Reclamation with its depots for cotton, grain etc., (4) the Prince's and Victoria Docks and (5) the Alexandra Dock and Ballard Pier.

THE STORAGE DEPOTS.

1. *Bulk Oil Installations.* The great bulk oil installations, some 83 acres in extent, are divided into three groups-(a) the liquid fuel and lubricating oil depots at Malet Bunder immediately north of the docks, (b) the Kerosene Oil Installations at Sewri and (c) the Petrol Installations still further to the north on the Wadala Reclamation. The total capacity of all the various oil depots is about 55,943,908 gallons. The Installations, which are all on land leased from the Port Trust, are served by the Bombay Port Trust Railway and have pipe line connections aggregating 20 miles in length to the several loading and discharging berths at the Docks and Pir Pao. Petrol and high grade kerosene are handled at the special berth at Pir Pao at the north end of the Harbour, a distance of 5½ miles from the storage tanks at Sewri and Wadala.

2. *The Cotton Depot*, which covers an area of 127 acres and is one of the largest in the world, was constructed in 1923 at a cost of £ 1,000,000. Situated on the western side of the Mazagaon-Sewri Reclamation, the Depot comprises 178 ferro-concrete godowns of a total capacity of one million bales, and 230 jethas or raised plinths (of which a few have covered monsoon protection) accommodating a like number. On each side of the Depot are 20 receiving and despatching stations *en echelon* and a railway yard with 8 miles of track. All the godowns are equipped with Grinnell Sprinklers and the depot has its own Fire Brigade, Salvage Corps Station, dispensaries, etc.

3. *The Grain Depot.*— To the east of the Cotton Depot, opposite the Port Trust Railway, lies the Grain Depot which, as regards lay-out and communications, is a model of its kind.

Over 80 acres in extent, it provides more than one million square feet of covered accommodation arranged in parallel rows of sheds 500 and 1000 feet long by 110 feet wide, equipped with excellent roads, water supply and electric lighting and power. Between each row of sheds are feeder lines off which run echelon sidings, import on one side and export on the other. Opened in 1914 for the reception, storage and shipment of grain and seeds, it has since been considerably extended to meet the increasing demand of other trades. An area of 7·83 acres of covered and open accommodation is now leased to General Motors, (India) Ltd. for their Assembly Factory.

Besides the above depots, there are several other storage depots for trades such as manganese ore, coal, building materials, hay and straw, etc.

Industrial sites, an area of close on 26 acres, laid out in conveniently sized plots admirably situated as regards road and rail facilities, have been set aside on one of the Trust's newest reclamations at Wadala.

Practically the whole of the Port Trust Docks and estates are on land reclaimed from the harbour. The reclamation carried to completion by the Trust during the first thirty years of its existence comprised 167 acres of foreshore land from Sewri Bunder on the north to Apollo Reclamation and the Colaba Bunders on the south. In 1908 the Trust embarked on the great Mazagaon-Sewri Reclamation scheme which was completed in 1912 and added 583 acres to the area of Bombay. Subsequent reclamations at Wadala, Tank Bunder and Colaba provided a further 310 acres. The total area of the Port Trust estates is 1880 acres or approximately one-eighth of the Bombay City and Island.

The Trustees' important estates are — (1) *Ballard Estate*, approximately 22 acres in extent, which is a first class business centre with 37 blocks of modern office buildings, (2) *Apollo*

Reclamation, the site of the former Cotton Green, approximately 43½ acres forming one of the Principal residential districts of Bombay, (3) *Sassoon Dock Estate*, approximately 17½ acres, surrounding the oldest of Bombay's wet docks, containing an extensive range of godowns formerly used for storage of cotton and now converted into motor and machine workshops, (4) *Elphinstone and Mody Bag Estates*, appoximately 175¾ acres, where are located warehouses, the Grain, Rice and Iron Markets and other storage godowns, shops and residences.

Antop Village. This is a model labour settlement on the northern portion of the Wadala Reclamation. The village was built in 1920 and covers an area of some 13 acres; it comprises 508 single-storeyed cottages laid out in blocks of varying sizes and provides accommodation for about 1800 residents consisting of Port Trust labourers and their families. The settlement is provided with shops, a dispensary, schools, gymnasium and playing grounds for adults and children. The supervision is under a qualified Indian doctor and the welfare work is in charge of a trained Y. M. C. A. worker. The scheme was in the nature of an experiment designed to prove the advantages to employers and workers alike, of hygienic living conditions coupled with reasonable opportunities for education and healthy recreation. The experiment has proved in every way successful. The Trust have also on other parts of their property quarters for their officers, staff and labourers which house approximately 3,500 persons.

The Trust possesses 6 dredgers, some of the very largest type, 13 hopper barges and a rock-breaker, besides numerous other craft. The dredgers are regularly employed in deepening and maintaining the channels and approaches.

The following figures show the gross revenue, expenditure, tonnage of goods handled and the volume of shipping (arrivals) for the past 10 years :—

Year	Revenue (including Pilotage)	Expenditure. (including Pilotage)	Tonnage of goods handled.	Shipping (including steamships and sailing vessels).	
				No. of vessels.	*Net Registered Tonnage.*
	Rs lakhs	Rs. lakhs.			
1923-24	2,60·72	2,61·90	6,256,000	58,492	5,157,551
1924-25	2,73·77	2,73·21	6,459,000	43,250	5,047,407
1925-26	2,84·14	2,76·54	6,460,000	48,370	5,115,470
1926-27	2,64·03	2,75·08	5,593,000	40,957	4,819,033
1927-28	2,81·07	2,73·53	6,649,000	40,928	5,367,251
1928-29	2,86·08	2,78·95	6,700,000	39,017	5,635,788
1929-30	2,81·07	2,76·23	6,688,000	39,527	5,822,009
1930-31	2,49·27	2,60·98	5,850,000	33,101	5,627,303
1931-32	2,32·42	2,54·34	5,138,000	31,515	5,676,895
1932-33	2,30·78	2,46·03	4,689,000	30,495	6,228,407

The total capital expenditure as on 31st March 1933 amounts to Rs. 24.14 crores. The total debt of the Board is Rs. 21.73 crores, repayment of which is provided for by annual sinking fund contributions from revenue; the accumulation of the sinking fund as on 31st March 1933 is Rs. 54.42 lakhs. In addition to this, apart from property appreciation, the Port possesses Reserve and other funds totalling Rs. 91. 46 lakhs.

TATA HYDRO-ELECTRIC PROJECTS, BOMBAY.

The Bombay Hydro-electric projects with their network of power stations, high voltage transmission and distribution lines, receiving stations and substations, provide power supply for all purposes in the city of Bombay. and surroundings. Starting service in February 1915 with only the Khopoli power station for supplying power in Bombay city to some 30 textile mills and a small portion of the general city load, the system has developed continuously to its present proportions comprising 3 power stations and a transmission line network supplying power for all purposes in several localities extending as far as Poona. A population of approximately 16 lakhs residing in areas totalling 350 square miles are now receiving from the Bombay Hydro-electric system, general power service including 31 miles of main railway electrification from Bombay to Kalyan.

The attached chart illustrates the relative locations of the storage lakes in the Ghats, the power houses, the transmission lines and distribution centres. The following are some of the principal physical characteristics and data of the combined Hydro Power system.

PARTICULARS OF MAIN FEATURES.

	HYDRO.				Andhra.		Tatal Power.
	Shirawta.	Walwhan.	Lonavla.				
1. Catchment Area Sq. Miles	11	5·5	5·4		48		95·6
2. Area of lake at F. S. L. Sq. Miles	5·05	2·4	5·1		12·5		14·85
3. Capacity in M. C. ft. above draw off level	6567	2560	414		12850		16120
			Main dam.	Waste weir.	Main dam.	Aux-dam.	
4. Length of Dam inc. waste weir	7607′	4450′	3615′	1725′	2432′	2200′	5123′
5. Section of Dam at top	12′	13′	14·5′	17·0′	15′	5′	18′
6. Section at lake bottom	51·2′	40·8′	17·5′	17·0′	148′	15′	108′
7. Height of dam above river bed.	83′	71′	34·5′	22′	190′	17	146′
8. Length of Waste Weir dam	1206′	1130′	644′	1000′	557′	...	1503′
9. Tunnel length	5000′				8700′		14850′
10. Tunnel section sq. ft.	93·5				82		140
11. Duct line length	22850′						
12. Duct area sq. ft	189 and 150						
13. Pipe Lines and Penstocks Nos. and diameter	2 × 82½/72″, 6 × 42/38″				6 × 42″, 6 × 38″		3 × 84″ 5 × 58/51″ 10 × 3[illegible]″

	Hydro.	Andhra.	Tata Power.
14. Pipe Lines Lengths	2 each 8200′, 6 each 4300′	6 each 2310′, 6 each 2290′,	3 each 140′, 5 each 3670′, 10 each 2070′,
15. Pipe Lines Tonnage	9700	6030	7500
16. Max. Head gross	1726′	1743′	1650′
17. Min. head gross	1564′	1670′	1601′
18. Generators ...	6	6	5
19. Size KW ...	8000	8000	17500
20. Total KW ...	48000	48000	87500
21. Generator Voltage	5000	5000	11000
22. Step up Transformers	15 ; 1	9	12
23. Size KVA each	3333 & 10000	8000	10000
24. Voltage Ratio ...	5000/100000	5000/100000	11000/110000
25. Transmission system	2 circuits of 100,000 volts 43 routemiles 1 circuit of 100,000 volts 7 route miles.	2 circuits of 100,000 volts 56 route miles 1 circuit of 100,000 volts 18 route miles.	2 circuits of 100,000 volts 119 route miles and 25 route miles of 22000 volt circuits.
Towers ...	4 legged	latticed steel	painted.
Average span ...		500′	
Maximum span ...		1175′	
Conductors ...	·095 sq. in. stranded copper and ·1045 sq. in. stranded aluminium with steel core, All lines protected with overhead ground wire throughout.		
26. Transformers step-down	15; 6	9	12 3
27. " size KVA each	3120 & 4000	7000	9000 4000

	Hydro.	Andhra.	Tata Power.
28. Voltage Ratio. ...	90000/6600 and 90000/22000	90000/22000	90000/22000 90000/22000
29. Receiving station Synchronous condensers for voltage regulation	4 of 16000 KVA. total	2 of 25000 KVA. total	2 of 25000 KVA. total.
30 Voltage of underground distribution cables. ...	6600 and 22000.	22000	22000
31. Miles of cables installed.		175	
32. Date of commencement of power supply. ...	Febry. 1915	Octr. 1922	April 1927.
33. Total capital cost		Rs. 15,67,00,000 -	
34. Service capacity of the lake storages (present) in KW. hrs. supplied annually to consumers.		580 millions.	
35. Average annual consumption last 3 years.		404 million K. W. hours.	
36. Load demand total during year ending June 1933.		131,500 K. W.	
37. Population of area served.		16 lakhs.	
38. Consumption of electricity per capita per annum.		252 K. W. hours.	
39. Percentage of existing power demand supplied by Hydro power.		70%	

With reserve capacity in all the stations and inter-connected transmission lines, the Bombay Hydro-electric system is well fitted to meet the growing power demands of the communities it serves. The Bombay Electric Supply and Tramways Co. Ltd., who distribute electric power in the city of Bombay, have been obtaining the whole of their power from the Hydro system since 1925 when they closed down their fuel power station; wherever Hydro power service has extended, the local power generating machinery, if any, has been permanently shut down, and in several cases moved to other centres in the country not at present served from a high voltage power transmission system.

It may be expected that in the matter of providing a community with one of its prime necessities, viz., continuous and economical power, the experience of the Electricity Commissioners in England will prove of equal benefit in Bombay territory in its general development. The approved plan is one of co-ordinated regional power service by well equipped central power stations designed and operated with a view to obtain the best conservancy of the power generating resources. The Bombay Hydro-electric systems are adequately equipped to contribute their full share in the programme of conservation and development—a development which must have been in the vision of their far-seeing founder, the late Mr. Jamshedji Tata.

NOTES ON THE BOMBAY GAS CO.'S WORKS AND DISTRIBUTION SYSTEM.

The Bombay Gas Works and Distribution system for supplying the Island of Bombay and Bandra are owned by the Bombay Gas Co., Ltd., (Incorporated in England), whose Head Office is in London. The Company were given the necessary power for a Public Supply under Bombay Act No. V of 1863, which has been modified from time to time. The Paid-up Capital to-day stands at £. 300,000. The Works stand on a site of over 9 acres and were designed by Mr. Thos. Hawksley of Hawksley Bros., Civil Engineers, Westminster, and the erection of same started in the year 1863. Gas was supplied for the first time in Bombay in 1866.

To-day very little of the original plant exists, as extensions and alterations have had to be made to meet with the ever-

increasing demand for gas. The present plant has a daily producing capacity of approximately 3,500,000 c. ft. of Coal Gas and 320,000 c. ft. of Water Gas or over 3,820,000 c. ft. daily.

The coal stores are arranged with a Railway Siding to store some 18,000 tons of coal. The Retort House is equipped with two benches containing 25 "through" settings of fireclay and silica retorts all built on the regenerative principle. The total number of mouthpieces is 300. The coke removed from the Retort House is taken out on the coke ground which has a storage capacity of some 1,000 tons. The coal carbonized in normal times is purchased from Bengal. The Water Gas Plant is one of the latest and improved type and is a complete unit in itself with the necessary powerful steam generating plant, blowers and steam turbines, etc.

The Coal Gas Plant consists of both annular air-cooled and water-tube type condensers, tar, naphthalene and ammonia extractors, also extensive tar storage and ammoniacal liquor wells and tanks with the necessary tar-distilling plant. There are also three rotary exhausters exhausting the gas from the Retort House and forcing it through the various washing and scrubbing plant on its way to the dry purification plant which consists of seven purifiers capable of holding over 1,000 tons of oxide of iron. The gas, after leaving this plant, is then registered by three large cylindrical-type station meters and goes forward to the 3 gas holders for storage and distribution purposes to the District after passing through the 3 station governors which control the pressure on the District.

The Works are equipped with an up-to-date chemical laboratory where constant analyses of the gas being manufactured and sent out are being made for calorific power, illuminating power and percentages of composition of the gas.

The Distribution System consists of some 200 miles of cast iron mains varying in size from 24″ down to 3″; service supplies represent some 400 miles of piping varying from 2″ down to ¾″; these in turn supply some 7000 public street lamps and in addition several thousand consumers of gas for light, heating and power purposes.

There are several stations throughout the Island for compressing gas for use on high pressure gas installations both for

Public Street lighting and for industrial purposes, an example of the latest type of installation is at the Britannia Biscuit Company's Factory at Kassara Basin. Gas is being used more and more daily for large cooking installations in clubs, hotels, hospitals and chemical laboratories, etc., and by many thousands of household consumers on account of its high efficiency, cleanliness, convenience and low cost compared with other heating agencies.

Gas as a domestic fuel for cooking and heating purposes and also for industrial uses has made enormous progress in western countries. Gas in Great Britain is known to be used in appoximately 3,000 trades or branches of trades for an average of seven processes in each, and in more than 9,000, 000 homes where heat is needed for something like a dozen household purposes. Below are some of the uses to which gas can be successfully adopted in India.

Metals:—Annealing, brazing, casehardening, forging, tempering, rivet and bar heating, die-casting, plate-heating and other heat-treatment processes.

Railways:— Heat-treatment of metals in workshops, railway wagon tyre-shrinking, hot-water requirements, staff canteens etc.

Shipbuilding:— Heating up plates and angle-irons, shrinking metals, heat-treatment of heavy forgings and high-speed steel, rivet-heating, glue pots, etc.

Motor Cars:—Heat-treatment of metals, core-drying, soldering, repairs, equipment for motor garages, repairs to buses, glue pots, etc.

Textiles:— Gassing, singeing, stentering, conditioning, shrinking, calendering, ironing, drying silk, etc.

Leather:—Heating, power, drying, melting, softening, sealing, and other processes; glue pots.

Printing:— Melting stereo-metal, drying materials, drying photographs, preparing plates, power, etc.

Food:—Bread, biscuit and pastry baking, canning, bottling and drying fruit; poultry farming (incubating), ripening, milk sterilizing, pasteurising, churn and bottle washing.

Catering:—Cooking, fish frying, heating, water heating, etc., in hotels, restaurants and boarding houses.

Confectionery:—Sugar boiling, sweet making, caramel, washing, etc.

Tobacco:—Drying, washing, conditioning, baking, tin sealing, soldering, gold blocking.

Varnishes, Paints and Lacquers:—Gum running, oil boiling, Lacquer and enamel drying.

Glass:—Glory holes, annealing, finishing, blow pipe work.

Brushes:—Melting pitch, sterilizing and dry brushes drying, japan, power.

Pianos:—Heating glue pots and cawl plates, drying, etc.

Shops.—Lighting, water-heating, equipment for canteens, baths, etc.

Laundries:—Ironing, power, lighting.

Hospitals, etc:—Catering, water-heating, sterilizing, laundering, laboratory and dental workshop equipment.

Schools:—Laboratories, baths, water-heating, workshops, cookery classes.

Street Lighting:—High and low pressure gas lamps.

Domestic Uses:—Cooking, water–heating, ironing, drying clothes etc.

The two main bye–products arising from the manufacture of Town's gas are coke and coal tar. From the distillation of one ton of Bengal coal are produced approximately 13 cwts. of coke and 12 gallons of tar. A portion of the coke is used in the furnaces which distil the gas and the balance is sold for heating and industrial purposes, and for domestic cooking. In the latter case it is broken and graded into a standard size and suitable sigries (or braziers) are made by the Company for this type of fuel. Coke is also used for manufacturing blue water–gas in combination with superheated steam.

The uses of coal tar are many and varied. Large quantities are used in making tar-macadam for road-surfacing, spraying, etc. Then, again, being of a light nature, it is highly suitable for preserving wooden railway–sleepers, and most other kinds of woodwork subject to the weather. It is also used for painting metals, protecting roofs against monsoon conditions and for the water-proofing of fishing–nets, tarpaulins, etc.

The Gas Company has large Offices and Showrooms where the latest gas-heated appliances are on view and are demonstrated. It employs large administrative and clerical staffs, and both directly and indirectly finds employment to thousands of Indian workmen, who are trained for posts of higher responsibility. The Company aims at highly efficient organisation giving good service to the general public, supplying its products at as low a charge as possible, and allocating only a reasonable annual return as interest for the captial invested.

William T. Lane.

THE BOMBAY ELECTRIC SUPPLY AND TRAMWAYS COMPANY, LIMITED.

The Bombay Electric Supply and Tramways Company purchases its supply of electrical energy in bulk from the Associated Tata Hydro Electric Companies, of which The Tata Hydro-Electric Agencis, Limited, are the Agents. Energy is received in bulk at the Company's Receiving Station at Kussara Basin, Mazagon, and at seven other points of supply as scheduled below:—

Points of Supply.	Capacity.	Voltage.
1. Kussara.	4 Banks of Transformers each having a capacity of 7,500 K. V. A.	22,000/5,500Volts
2. Kingsway.	2-3 phase Transformers, each having a capacity of 1,750 K. V. A.	22,000/6,600 „
3 Mahim.	3-3 phase Transformers, each having a capacity of 250 K. V. A.	22,000/6,600 „
4. Match Factory	Up to 200 K. V. A.	6,600 „
5. Palton.	„ 2000 K. V. A.	6,600 „
6. Esplanade.	„ 5500 K. V. A.	6,600 „
7. Lal Baug.	„ 1000 K. V. A.	6,600 „
8. Supari Baug.	„ 1000 K. V. A.	6,600 „

Distributions.—The H. T. Supply from the above mentioned eight Receiving Stations is distributed through E.H.T. Feeders to about 102 Static Substations. The E. H. T. Network consists principally of 15 sq. inch E. H. T. 3 core P.I.L.S. cables, laid on the solid system at a depth of about 3 feet.

The H. T. voltage is reduced in the Static substations from 6,600 or 5,500 to 400/200 volts, 4 wire A. C. A. C. Supply is thus available to the public in certain areas, at 230 volts, 50 periods for lighting, and at 400 volts 3 phase for Power purposes.

In the Fort area, however, the supply, 3 wire D. C. at 230 and 460 volts, is obtained from 5 Rotary substations equipped with Rotary converters and 1 Rectifier Station.

The A. C. L. T. Network consists largely of 4 core Armoured Disributors chiefly of the following sizes:—0.2, 0.1 and 3.06 sq. inch. The D. C. Network in the Fort area consists chiefly of 0.2, 0.1, 0.2 V. B. Combination.

Armoured cables are laid directly in the ground at a depth of about 2′-6″. L. T. cables are rarely laid on the solid system except for the V. B. Combinations. Wherever possible, all cables are laid under footpaths.

In recent years, the Company's Distribution System has been greatly improved by erecting automatic substations and protecting other stations against the higher short circuit stresses due to the Hydro Supply. The Company is constantly at work improving the whole of the substation equipment, and an example of this policy is the installation of Mercury Arc Rectifiers at its Kingsway and Ormiston Road Substations.

Rates and Tariffs.—The important rates charged for energy to the public per Kilowatt Hour are :—

(a) *Lighting and Fans.* 4.5 and 4.0 annas per unit for business and residential premises respectively.

(b) *Heating and Cooking* (*Domestic*) 1 anna per unit.

(c) *Power.*

(i) For motors from 5 B. H. P. to 10 B. H. P. 2 annas per unit.

(ii) For motors above 10 B. H. P. Rs. 8 per K. W. of Maximum Demand per month + $\frac{2}{3}$rds annas per unit consumed.

(d) *Public Lighting.* The Company has now installed about 1450 electric lamps at various points and on different roads in the City. The Municipal Corporation specify the size of lamps to be erected, and pay yearly rates for the lighting and maintenance thereof.

'*Best*' *Showrooms.*—The Company owns extensive Showrooms at the Corner of Ormiston Road and Colaba Causeway, where modern domestic electrical equipment and lighting fittings are displayed and demonstrated. In conjunction with the Showrooms, the hire of domestic refrigerators, water heaters and cookers is carried out at very low rates, with the result that these appliances are now available to a much wider public than would otherwise be able to avail themselves of such conveniences. For example, there are now more than 1400 refrigerators installed in Bombay and this number is rapidly increasing.

Since 1923, the number of consumers of electrical energy has increased from 30,485 to 57,009, an increase of 87%

The number of units sold has increased from 519 lakhs in 1923 to 678 lakhs in 1932, an increase of 30. 6%

Tramways.—The Tramways Rotary Substations are situated at Esplanade and Kingsway, where H. T. Supply is converted into D. C. Supply at 550/600 volts by Rotary Converters and Mercury Arc Rectifier.

The distribution system consists of Positive Feeders (mostly 5 sq. inch in section) which feed the Overhead Trolley wire at 18 feeding points. The Trolley wire used is No. OO B & S Grooved Copper. Current returns to the substations through the rails. Negative boosters are Esplanade substation and negative feeders are employed to keep the voltage drop within the limits prescribed under the Indian Electricity Act.

The Permanent Way consists of B. S. S. No. 1 and 1c (90 and 96 lbs.) tramway rails laid on transverse teak sleepers on either a concrete or rubble bed. Where extra heavy vehicular traffic is prevalent, as in the " Docks Area ", the rails are laid and anchored directly on the concrete bed. The track gauge is 4.′-8½″. Track relaying is carried out on a 9″ concrete bed, rails B. S. S. No. 6 and 6c (96. 4 and 103. 2 lbs.) being directly anchored to the concrete.

A large portion of the track surface of the Permanent Way which is repairable by the Company, has been treated with asphalt penetration to minimise dust. Sett stone paving is employed on sections subjected to very heavy traffic. The equivalent length of single track is 56. 98 miles, of which about 28·49 miles is double track.

Rolling Stock.— The Company owns 451 tramcars, which run singly or permanently coupled together, forming 266 car-units. All tramcars are built by the Company in Bombay in their own Workshops at Kingsway, the trucks and electrical equipment being imported from overseas. The BEST Workshops are equipped with modern machinery and provide employment for about 500 men daily. The Workshops Superintendent is the Chairman of an excellent Safety Committee, established in this Workshop. Accidents are enquired into and suggestions for their prevention are discussed and adopted.

Passengers carried in 1932 fell down from 93,800,704 in 1931 to 85,590, 552. The Communal Disturbances of May 1932 and their aftermath dealt the heaviest blow on the Tramway Branch. The car miles run by units during this period were just over 5 millions.

Omnibuses.— The Company also owns 60 motor omnibuses. Route miles covered are·25·49 in 1932. Over 8½ millions passengers were carried and the miles run were above 1½ millions.

The Company has recently purchased 8 Albion Valkyrie chasses equipped with Gardner L. W. 4 light C. 1 engines. 32-seater bodies for these chassis are now being built in the BEST Workshops, and it is hoped to put these vehicles into commission early in 1934.

'Best' Training of Apprentices.— No description of the BEST Organisation would be complete without reference to the scheme for the training of apprentices instituted by the Company as far back as 1907. The system of instruction was considerably modified and brought uptodate in 1920. Further improvements were made in 1932 when the existing courses were revised to meet the industry's requirements in addition to the introduction of several new courses. That the efforts of the Company in this direction are meeting a real need is proved by

the fact that whereas in 1907 two apprentices were trained, now as many as 69 are trained per annum. There are in all 10 different courses varying from a period of 12 weeks to 3 years, designed for the training of boys straight from the school and students of Engineering Colleges. Admission for special apprenticeship is open to students of Engineering Colleges from all over India whilst that for School Apprenticeship course is restricted to bona fide natives of the Bombay Presidency. The syllabus of College Apprenticeship Courses – Vocational – for a period of 3 or 6 months either in the Meter Department, or Photometric Department, or Installations, or Substations, or Costing or Domestic Appliances Service Department is a special feature of BEST Apprenticeship, framed to assist College Students to obtain practical experience during their vacations.

A. S. TROLLIP.

BOMBAY TELEPHONE SERVICE.

The Bombay Telephone Co. Ltd. formed in 1882 recently celebrated its jubilee of public service. It has grown gradually year by year until today it serves 9218 subscribers in the islands of Bombay, Trombay and Salsette.

In addition, the Company also maintains manually operated plants in Ahmedabad and Karachi. The existing equipment in the former city will shortly be replaced by the latest type of machine switching equipment.

The manually operated plant in Bombay was replaced in 1924 by an uptodate machine switching system, since when the equipment has gone through changes and improvements increasing the facilities to the Company's subscribers.

There are now six machine-switching exchanges and one manual exchange serving the following districts:—

	Exchange.	*Equipment.*	*District.*
Bombay Island.	Central	7000 Lines	Kalbadevi, Fort, Ballard Estate, Colaba.
	Gell Street	3000 Lines	Malabar Hill, Byculla, Parel, Sewree.
	Naigaum	600 Lines	Dadar, Matunga Mahim.

Salsette Island.	Bandra	300 Lines	Bandra, Khar, Santa Cruz.
	Andheri	150 Lines	Andheri, Vile Parle, Versova, Juhu.
	Ghatkopar	100 Lines	Ghatkopar, Kurla, Chembur.
	Thana (Manual)	100 Lines	Thana, Kopri, Mulund.

All exchanges are easily extendable and the whole of the Strowger machine-switching equipment was manufactured by the Automatic Electric Company, Limited of Liverpool.

The advantages of machine-switching over a manually operated system for a multi-office service are many, some of which are enumerated below.

(a) Speed of set up; immediately the last digit is dialled the calling party is advised whether the line is engaged or not. If not, the called party's bell is rung at once.

(b) The language difficulty is obviated in that the "Dial" with its arabic figures is readily understood by all nationals.

(c) A full load service can be given any time during the day, a feature which would be impossible in a manually operated system.

(d) Junction calls i. e. calls to another exchange are set up with the same ease and rapidity as a local call. Under manual conditions two operators would be necessary for this traffic.

The switching scheme used in Bombay is arranged on a one hundred thousand basis, which makes a five digit number universal for all subscribers. The first digit functioning as a code digit and the remaining four digits indicating the subscriber's number in the called exchange. There is a small modification to this in the case of exchanges situated on Salsette Island. As these exchanges are arranged on an ultimate basis of 1000 lines each, the second digit acts as a hidden code indicating the exchange in Salsette area.

The Strowger system which is employed in the Bombay exchanges is of the step type operating on a decimal basis. With

this system of grouping the digits of the number indicates the location of the line; thus No. 28575 indicates line No. 75 in the third hundred, of the fourth thousand, in Central Exchange.

The selection of a line proceeds by successive choice, first the exchange code is selected, then the thousand group in that exchange, followed by the hundred in the thousand, and finally the tens and unit in the selected hundred.

The Switch mechanism consists of a shaft carrying a pair of springs, or wipers. The shaft is operated in a vertical and horizontal direction by means of pivoted arms actuated by electromagnets. The whole assembly is controlled by the actions of several relays. Associated with the mechanism is a bank of contacts, each of which is a small flat piece of brass. These contacts are arranged in pairs (100 pairs is a complete bank) and the movement of the shaft connects the wipers to a particular pair.

The shaft moves in direct accordance with the digit set up by the subscriber when the dial is operated, and the succession of digits makes the complete set up.

The release of the call is controlled by the mere action of the subscriber placing the receiver on the rest, thereby restoring all switches to normal.

Three tones are employed to indicate to the calling subscriber conditions in the exchange.

The dial tone, sounding rather like the purring of a cat informs the subscriber that the exchange is ready to receive his call, and is heard immediately the receiver is removed from its rest.

The busy tone, a musical note, giving the signal; buzz, buzz, buzz at regular intervals indicates that the called party's line is engaged.

The ringing tone, with the signal buzz, buzz, silence; buzz buzz, silence etc. is of the same periodicity as the ringing of a subscriber's bell and notifies the calling subscriber that the bell of the called number is being rung.

The electromotive force required to operate the exchange is supplied by 50 volt batteries, two of which are fitted to each

exchange. These batteries are charged by means of duplicate motor generator sets driven off the available supply mains, the "modus operandi" being that one battery is on discharge whilst the other is on charge. This allows a standby, should the supply mains fail.

Central Exchange serving the business district of Bombay, has 5650 working lines, carries an average daily load of 1,80,000 calls, of which about 1,50,000 are handled between 11 a.m. and 6 p.m. The peak load between 11–30 and 12–30 being equal to about 35,000 calls. This calling rate gives the extremely high average of 5·5 calls per working exchange line, which is believed to be the highest in the world. This high rate is caused to some extent by the impatience of subscribers who, on finding a called number engaged, insist on making two or three calls to the same line immediately, with no thought of the fact that the party wanted might be in earnest communication.

All exchanges experience a small load about 9·30 at night due to the closing of the American cotton market. This is particularly noticeable in the suburban exchanges in Salsette Island.

Extensive use is made of dry core paper insulated underground cable, both armoured and solid laid cable being employed.

In larger blocks of offices and flats the cable is laid direct into the building thus obviating the use of unsightly poles and iron brackets, and materially reducing the number of likely faults.

Junction cables between exchanges are "loaded" at predetermined intervals with inductances. These inductances balance the capacity of the cable thereby reducing the opposition to speech currents. The loading coils are arranged in groups of 25, 50 or 100 dependent on the size of the cable. Each coil is separately shielded by means of large copper washers, the whole assembly being sealed in an iron pot filled with suitable compound. Lead covered silk and cotton tails are brought out and jointed into the cable.

Subscribers' apparatus is assembled locally in the Company's Workshops at Byculla. All ringer boxes are made of best Burma teak finished with a clear spray polish.

As the extremely humid climate in Bombay has a very deteriorating effect on instrument wiring, the usual double silk and cotton insulated, laced wiring has been abandoned. In its place is used No. 18 bare tinned copper wire. The wires are formed and being air spaced low insulation does not result. In addition all terminals are mounted on blocks of polished bakelite instead of directly on to the teak case.

Private Branch Exchange Switchboards are fitted during the monsoon with a 16 C. P. carbon filament lamp which helps very considerably to prevent moisture forming at the interior apparatus.

Many subscribers take advantage of the Private Branch Exchange equipment in which two or more lines may be listed in the directory under one telephone number. When such a call is set up it is mechanically routed to the first disengaged line, the engaged tone being heard if all lines are engaged. The advantage of this service can be readily appreciated over separate directory listings for each line.

The 2-Party Line system has proved exceedingly popular and many subscribers have availed themselves of this service for residential purposes. Each party is listed under a separate number in the directory and conversations are absolutely secret.

Public call offices have been developed and some 45 now give useful facilities to the public outside their homes and offices. The coin boxes which are fully automatic are arranged for the deposit of a two anna piece to allow the call to be set up. The coin may be returned if a " no reply " or ' engaged " tone result, the money only being collected when the call is effective.

Enquiries and complaints from subscribers are handled at special desks staffed by operators. Information not only regarding subscribers ' telephones, but details of departures and arrivals of mail and other steamers, trains, air mails etc. are available. During the M. C. C. cricket matches the telephone minded public took full advantage of the special service whereby the dialling of ' O ' connected them to an operator who was able to give full details of the cricket match then in progress.

The recently developed hand microtelephone with its ultra-modern moulded case met with immediate popularity on arrival

in Bombay. Its emersed electrode transmitter shows an improvement in speech of about 40% over the older type of transmitter, and its circuit arrangement is such that " side tone " is considerably reduced, thus affording easier speech.

Bombay, " Urbs Primus in Indus ", is well maintained in her telephone service which now provides 11972 subscribers stations in the area.

W. A. C. BROMHAM.

REFRIGERATION IN BOMBAY

Until 1924 the only plant in Bombay so far as is known was a small installation at the Grant Medical College used to store bodies for autopsies in connection with the Coroner's Court. In 1921 a four roomed plant was installed at the Arthur Crawford Market to store fish and fruit. Each room has a floor space of 600 sqare feet and a height of 7 feet with capacity for 21 tons of fish or 33 tons of fruit. The ammonia system is used with Lightfoot Compressor and a sixty horse-power electric engine. Three years' experiments in storing mangoes in this refrigerator by the Horticulturist to Government in 1929 proved successful and made possible the mango shipments to England in 1932 and 1933.

In 1922 the Taj Mahal Hotel installed a small petrol-engine and a two-roomed brine system store with one ton storage capacity. An up-to-date installation on brine system with a very efficient ventilating arrangement has just been built at the new Gordhandas Sunderdas Medical College. It is designed for storing nine bodies for post mortem and has some original and interesting features. The power unit is electrical.

The Bombay Municipality has erected another small 100-ton plant similar to the one in Crawford Market at the New Chowpatty Market for fish, but the machinery has not yet been installed there.

Recently in 1933 a new cold store has been opened on Mint Road by private interests. It consists of a large number of small rooms and is mostly storing European imported fish and meat and sausages, cheese, films, etc.

C. M. FLANDERS.

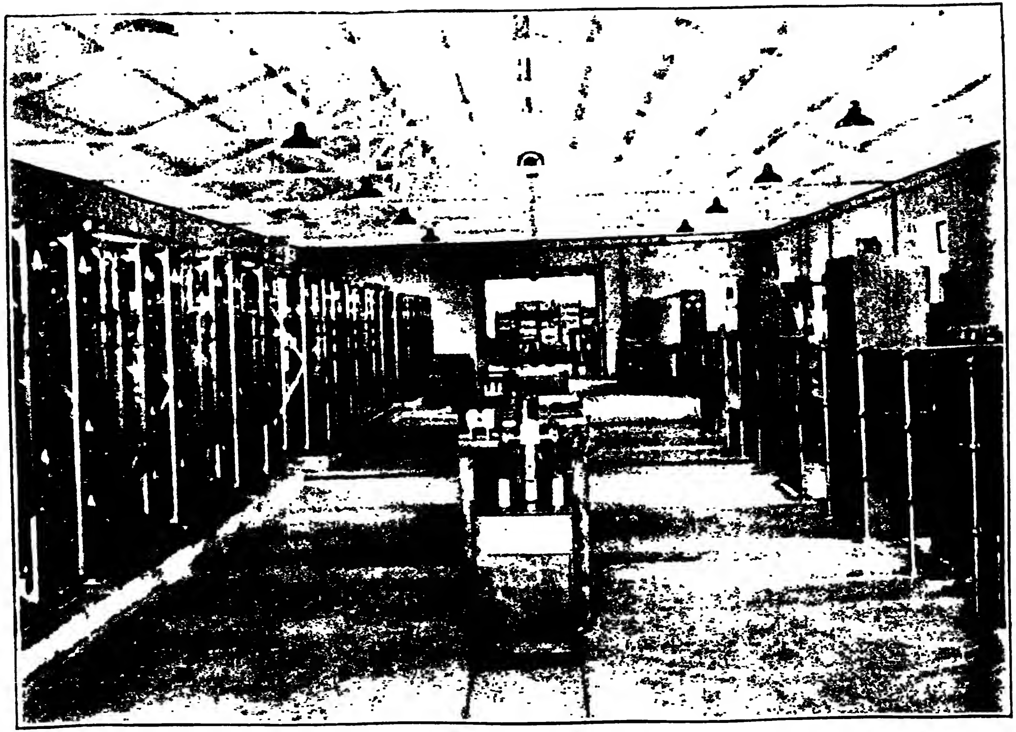
INDIAN RADIO & CABLE COMMUNICATIONS CO., LD.

Radio as a vehicle of domestic and international communications has attained a dominant place amongst the means that science has placed at our disposal. Particularly since the Indian Science Congress last met in Bombay, some great strides have been made in the direction of providing cheap and expeditious channels for overseas communication from India.

About that time the Indian Radio Telegraph Company (now the Indian Radio & Cable Communications Co. Ltd.) had just come into existence with a two-fold purpose. One was to establish a high speed radio telegraph service with England open to the public day and night and at rates appreciably lower than those prevailing then. The second object was the acquisition of the patent rights of the Marconi Company of London for exploitation in India and providing the domestic requirements for Marine, Police, Military and Aerodrome communications and also broadcasting.

The radio telegraph service ultimately established is on the principle of the MARCONI "Beam". The title "Beam" is borrowed from optics and refers to a narrow pencil of rays of light or energy. When it is realised that long distance communication is essentially point to point, it will be seen that out of the energy radiated by an aerial all but a small fraction is wasted. Hence directional aerials have long been tried with more or less of success. The beam aerial here adopted is the outcome of the extensive experiments of the Marconi Company on the polar curve of radiation from spaced aerials. The aerial system is supported on five masts each 280 ft. high providing four bays each 250 ft. wide. The masts carry 90 ft. cross arms at the top. On these cross arms is supported a double catenary of steel wire rope from which the individual beam aerial elements are supported. A quarter wave behind this row of aerials is a second row known as reflectors.

An elaborate system of concentric tube feeders enables energy to be transferred to the various elements in the correct phase relationship. Two of the 4 bays are used for the day time wavelength of about 16 metres, and the other two for the night wave of about 32 metres. The radiated beam is confined to



Radio Beam Station, Kirkee

The Tata Power Co, Ltd.

Bird's eye view of Generating Station and Penstocks at Bhira.

an angle of some 12 degrees in a direction at right angles to the plane of the aerials, and bears right on Skegness, the receiving station in England.

The beam aerial and the entire transmitting installation are at Dighi, 8 miles from Poona along the Alandi Road. The primary power for transmission is obtained from Diesel Engine driven alternators. Shortwave equipments are susceptible to frequency variation through mechanical vibration of foundations and supports. Hence to minimise vibration of floor, the above engines have been installed on concrete blocks resting on cork slabs. Transformers and other subsidiary machinery supply the filament and anode power of the transmitter. High voltage D. C. for power valves is obtained through rectification.

The wireless transmitter consists of a Master Oscillator and frequency multiplier stage, intermediate stages of amplification leading to a final power stage capable of handling about 20 kilowatts. In this stage valves cooled by oil circulation, known as C. A. T. type are employed. Energy from the high frequency circuits of C. A. T. valves is distributed to the aerial through the feeder system referred to earlier.

Keying is done by the absorber method in which the absorber valves provide a spacing load on the power supply equivalent to the marking load. Hence fluctuation in power supply voltage is minimised leading to higher stability of the radio frequency generated. The normal speed of signalling is about 1‾0 to 200 words per minute.

The receiving station of the Indian terminal is at Dhond. The receiving aerial and the feeder are similar to those at the transmitting end The shortwave receiver is of the double detector superhetrodyne type and is built on the unit principle with very elaborate provision for shielding.

Both the transmitter and receiver are remotely controlled from Bombay where is concentrated the requisite high speed gear consisting of Wheatstone transmitters, syphon recorders, keyboard perforators and such other telegraph accessories. For actual control carrier current telegraph and telephone channels are provided between Bombay, Dighi and Dhond on the existing Government trunk lines.

The service to England was inaugurated by H. E. Lord Irwin on July 23rd, 1927. After a series of official tests carried out in conjunction with the British Post Office authorities lasting over a week of continuous communication, the service was opened to the public on 6th September 1927. The amount of traffic in words handled by this service since its inauguration is shown below :—

1928.	1929	1930.	1931.
114,87,741.	129,32,764.	124,95,434.	127,45,952.

Since the introduction of high speed beam transmission for long distance telegraph services, cable communication systems of the world have greatly suffered on account of competition from the beam. As a result there has been an amalgamation of cable and wireless interests in England which are now controlled by the Imperial & International Communications Co. Ltd. At this end the Indian Radio Telegraph Co. Ltd., under its new name the Indian Radio & Cable Communications Co. Ltd., took over control of the cables in the Indian waters. previously owned by Eastern Telegraph & Associated Cable Companies. This merger was effected about the middle of 1932, and the combined traffic handled during the year amounted to 202,99,131 words.

The demand for a cheap and rapid telegraph service to Japan having keenly arisen owing to the growth of commerce between the countries, the I. R. & C. C. early this year inaugurated a direct high speed beam service to Japan. The transmitter, receiving and controlling equipments are concentrated at Dighi, Dhond and Bombay along side the English service gear. This Indo-Japanese service was opened to the public on 11th January 1933.

The latest in the field of overseas communication channels provided by this Company, is a direct radio telephone service to England. This was inaugurated on 1st May 1933 by His Excellency Sir Frederick Sykes, Governor of Bombay. It is now possible on this service to get into touch with U. S. A., Australia, France and a number of other European countries which are served by the extensive radio and cable telephone network of the British Post Office.

Coming now to the second important activity of this Company namely the exploitation of Marconi patents, it may be pointed out that the Company has supplied from time to time transmitting and receiving equipments for railways, harbours, aerodromes and a number of point to point services in Indian States. Amongst the more important of these may be mentioned the long wave equipments at Madras and Rangoon the ship stations at Calcutta, Bombay and Bedi Port and the Aerodrome equipments at Karachi and Rangoon.

Particular attention may be drawn to the equipments at a few of these stations. At Karachi there is a special direction finding equipment known as the Marconi-Adcock type. The usual method of Direction Finding with the help of Bellini-Tosi aerials severely suffers from unreliability and lack of definiteness during periods of dusk. This is attributed to the abnormal polarisation of waves at sunset and sunrise, which induces out-of-phase voltages in the balanced aerial system. The Adcock aerial on the other hand is least effected by such polarisation of waves. Here four aerials are erected at the four corners of a square and are connected by specially shielded underground feeders to a symmetrically disposed receiving hut. These aerials being responsive only to normally polarised radiation, take little account of abnormal wave fronts, particularly such as arrive from aeroplane aerials. Hence the Adcock system has special application at Aerodrome Direction Finding Stations. Two such equipments are at Karachi and Rangoon on the international air route between Europe, East Indies and Australia.

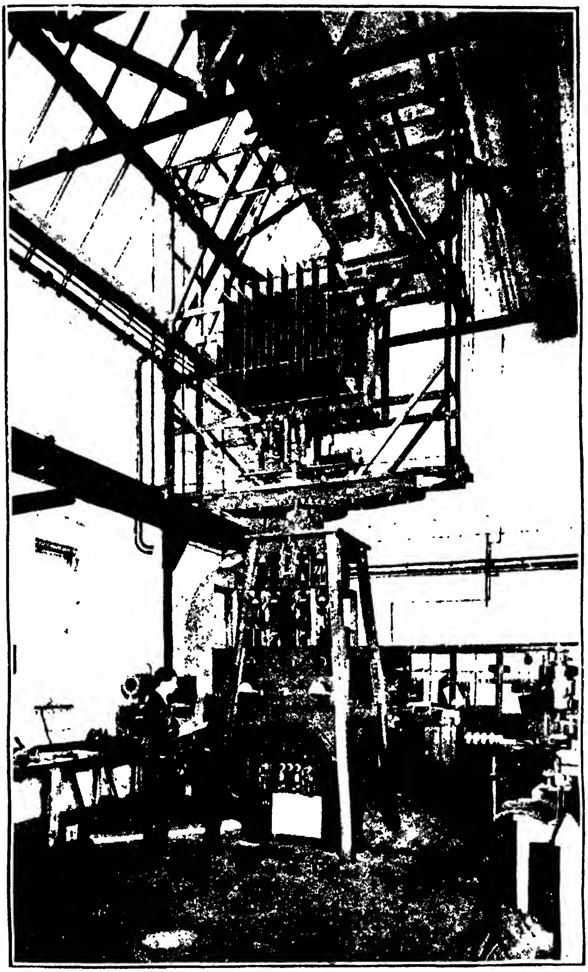
The second item of special interest is the Automatic Radio Beacon at the Kennery Island just outside the Bombay Harbour. Although called a beacon, the station has essentially a non-directional aerial working on a wavelength of about 1050 metres and transmitting only its call sign VWK at regular intervals of time. The interesting features of the equipment lie in the fact that the station is entirely automatic in its operation. From the starting of an oil engine, driving a generator, regulating the charging of a 52 volt battery, switching on the transmitter, signalling the call sign and shutting down the entire equipment – all this sequence of operations is carried out by

a Master Clock. In consequence the necessity for technical personnel in attendance is eliminated. This beacon is an important navigational landmark for ships in the Arabian sea as it enables them to take frequent bearings on the beacon for estimation of their own true bearing.

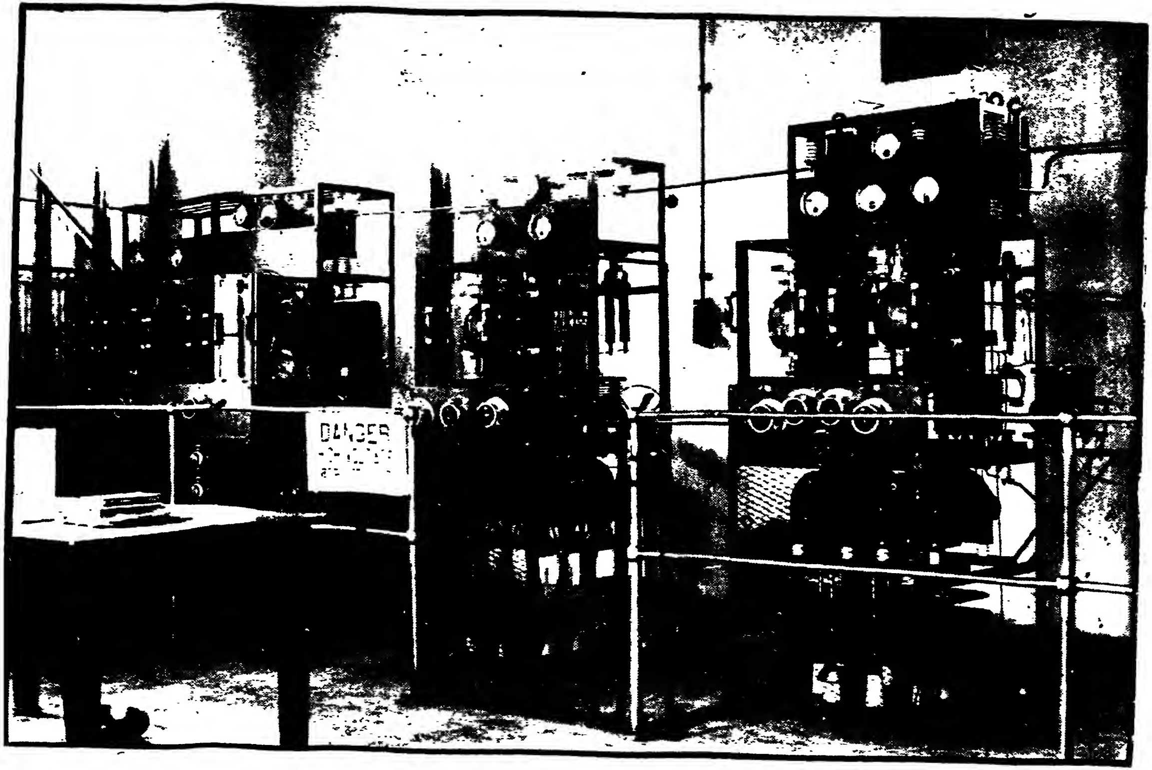
Equally interesting is the Rotating Radio Beacon near Rangoon. This is for the use of shipping making for the Rangoon port. The aerial system here consists of a multi-turn square loop mounted on a spindle with the plane of the loop in the vertical line. The loop is kept revolving at the rate of one revolution per minute and energy supplied to it via a pair of slip-rings. It is well known that the polar curve of radiation from a loop aerial is made up of two circles tangential to each other like (∞) and goes by the name " figure of 8 " on account of similarity. Listening to the radiation from such a loop one hears at regular intervals a loud signal followed a few seconds later by a weak or zero signal. This occurs twice per revolution of loop. When the plane of the loop is in the east-west direction it transmits a characteristic signal known as the "North Signal." The time interval between the reception of the North Signal and the following minimum or zero signal, gives in seconds the bearing of the observer and as the loop makes one revolution per minute each second represents 6° of the compass. Hence the stop watch for such purposes is calibrated in terms of degrees and one's bearing from a beacon observation is directly read off the stop watch. The observer need have only an ordinary receiver and a stop watch for purposes of direction finding around a radio beacon of the revolving type.

The medium wave 12 k. w. type Q broadcasting equipments now at Bombay and Calcutta were also installed and worked by this Company until the broadcasting service was taken over by the Government.

Finally as Sole Licensee in India and Burma of Messrs. Marconi's Wireless Telegraph Company Limited, this Company has been handling extensive enquiries for Marconi transmitting and receiving equipments, working out detailed specifications, lay-outs and estimates of projects covering a variety of interests such as long distance beam services, point to point communica-



Rotating Radio Beacon



Indian States Broadcasting Co.'s Transmitting Station

[Page 205]

tions, coastal and harbour equipments, Police and Military sets and also complete broadcasting equipments.

S. R. KANTABET.

BOMBAY BROADCASTING STATION.

As in many other fields of Industrial activity, in the field of Broadcasting also Bombay has set the way for the rest of India. It was at Bombay that the first Broadcasting Transmitter was installed so early as in the year 1924. It was the enterprise of a well known Commercial Firm and the Transmitter installed was rated 500 watts. This was soon followed up by small power Transmitters erected at Calcutta and Madras by the respective Radio Clubs of the places. No great notice was taken of these transmissions by the public. The number of supporters of each station could be counted on one's fingers. The stations simply died out. But the idea had caught on all the same. A few prominent business men of Bombay got together and floated the Indian Broadcasting Company for the purpose of erecting Broadcasting Stations all over India. Their hopes were high and as a first step they erected at Bombay and Calcutta what were in those days the most powerful Broadcast Transmitters. They stinted neither money nor energy in providing portions of India with information and entertainment of high order. But like all pioneers, they were a little ahead of the times and their endeavour met with no financial success. Let alone progress, even continuance of the two stations became difficult. This was in a large measure due to pirates among listeners as well as lack of organised propaganda on the part of the radio dealers.

In 1930 the Company could no longer support the burden of working the two stations and after a certain amount of deliberation the Government of India decided to take charge of the Stations and continue the service though on a very much more restricted scale.

Since then the Indian State Broadcasting Service, as it has come to be called, has continued the working of the stations. There have been vicissitudes in its short history. In November 1931, the Government of India passed orders for the closing down of the Service and served notices on its employees. But broadcasting had by that time proved its right for existence and

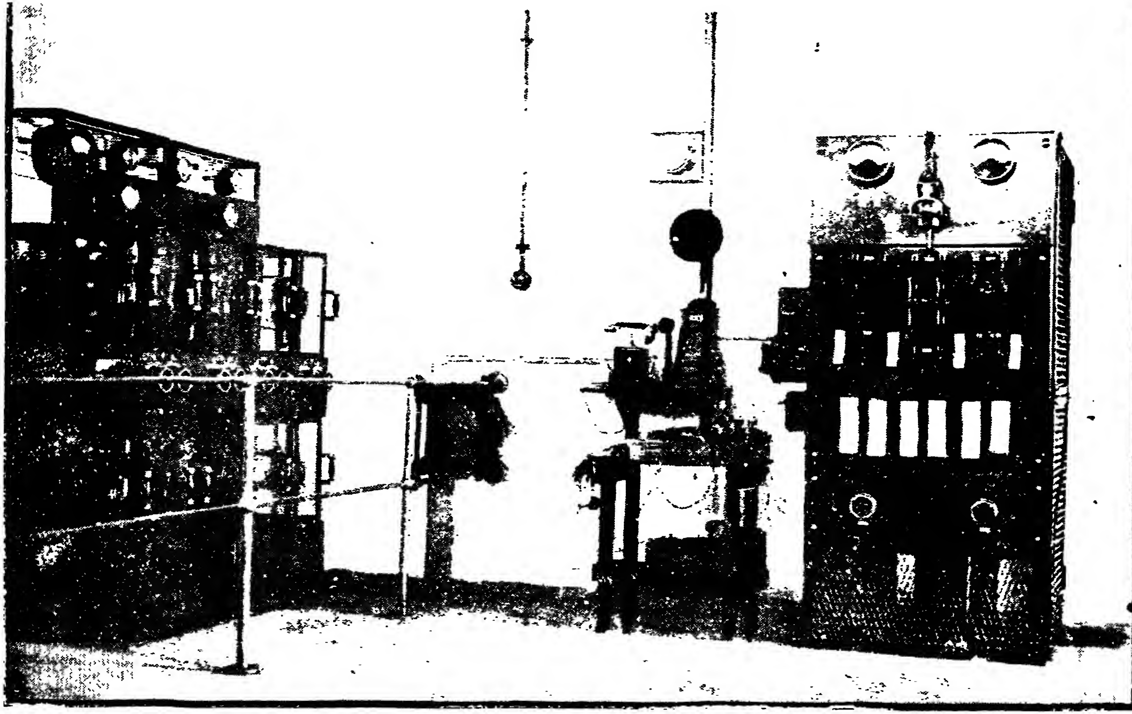
in spite of the very severe financial depression and the loss anticipated from the continance of the stations, the Government consented to continue their working.

The Bombay Broadcasting Station is equipped with a Marconi 'Q type' transmitter rated 12 K. W. The Studio equipment of the station is also manufactured by Marconi's Wireless Telegraphs Commpany, Chelmsford.

The Studios and Control Room are at present situated at Irwin House, Ballard Estate, Bombay. There are two Studios, the first, a spacious one for Orchestras and the second, a small one from which News items and recorded music programme emanate.

The tiny electrical currents produced by speech in the Microphone circuits are led by a system of change-over switches to the first stage amplifiers where these are amplified to an easily audible level. The output of these first stage or "A" amplifiers is fed into the 'B' or line amplifiers for further amplification. These line amplifiers are capable of giving a speech output of over 40 decibels, without any trace of distortion. This output which can be controlled by the programme controller at Irwin House to the required modulation level of the Transmitter is fed into the input terminals of the cable connecting the control room at Irwin House to the Transmitter at Worli, 7 miles away. This connecting cable consists of 3 pairs of paper insulated 10 lbs. conductors. One pair is used for conveying the programme, the second is used for inter-communication between the control room and the Transmitter and the third is kept as spare for use in an emergency. At the control room the amplifiers derive their power from batteries which are installed complete with charging gear. These are accommodated in a room adjoining the control room.

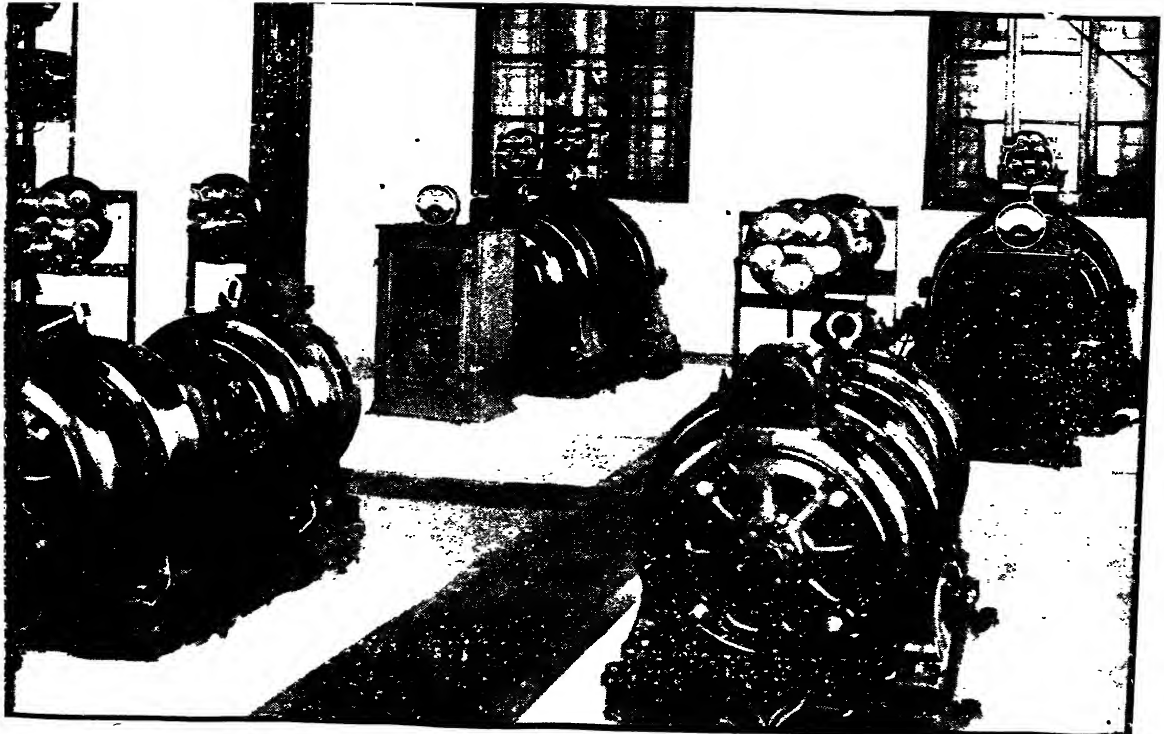
The Broadcast transmitter which is situated at Worli derives its power from the Bombay E. S. and T. Co. Ltd. The incoming supply is 400 volts 3 phase A. C. 50 cycles. This is converted by motor alternator units to 500 volts single phase A. C 300 cycles. This 300 cycles A. C. is fed into the power transformers for being stepped upto 23,000 volts. This H. T. Alternating



Indian States Broadcasting Co.'s Machine Room.

Switch-gear and Control-room

[Page 206



Indian States Broadcasting Co.'s Machine Room,

Power-house and Dynamo-room

[Page 207

Current is fed into a valve rectifier panel consisting of four M. R. 7 A Type valves arranged for full wave rectification. Maximum output of this panel is about 750 m. a. at 10,000 volts D. C. The rectifier valve filaments are rated 12 to 13 volts and are fed off the 500 volts 300 cycles single phase alternating current supply by means of a step down transformer.

The Transmitter which is of the ' driven ' type has its source of high frequency energy in the ' drive ' panel which has a single Marconi M. T. 2 type valve for converting D. C. energy into the high frequency energy of the required wave-length viz, 357.1 m. or 840 k/c. This oscillator is self-driven and maintains a very stable high frequency output as the load on it is small and of an unvarying type.

The main high frequency power at the station frequency, which is fed into the aerial system is derived from what is called the ' magnifier ' panel where the high frequency current generated by the drive is amplified by a pair of Marconi M. T. 9 valves working in parallel to the level required for feeding into the aerial-earth system. These valves are individually rated for 750 watts anode dissipation at 10,000 volts D. C. and are capable of giving a maximum high frequency output of about 2 k. w. each. The actual D. C. input into this power stage is about 3000 m. a. at 9000–9600 volts and the high frequency power fed into the aerial-earth system is just over 2 k. w.

On this sinusoidal high frequency current, which is at the station frequency is super-imposed the amplified current obtained from the microphonic or reproducer source. The audio-frequency currents forming the programme which are received at the Transmitter through the inter-connecting cable are fed into the grid of an M. T. 4 B. valve functioning as a sub-modulator where the audio-frequency voltage of these speech currents is stepped up to the order of about 200 volts. From the sub-modulator the speech currents are fed into the grids of the modulator valves which are of the Marconi M. T. 7 B type. There are seven of these valves working in parallel and here the speech currents are finally amplified to a voltage level which is commensurate with the voltage swing of the sinusoidal ' carrier ' or H. F. currents produced by the Magnifier panel.

The method of modulation adopted is generally known as the high power parallel plate modulation. The varying high tension audio-frequency voltage which now represents the tiny microphonic currents is debarred from going into the rectifier and machine side of the Transmitter gear by what is called "the speech choke," which offers a very high resistance to the flow of currents at audio-frequency. This varying voltage therefore varies the direct current voltage applied to the Magnifier valves and if the adjustments all along the route of the microphonic currents have been proper, the applied D. C. voltage is varied exactly in proportion to the tiny audio frequency voltage developed across miscrophone terminals. Now if the Magnifier is worked at a proper excitation and load level, the aerial power is varied in exactly in the same proportion as the varying D. C. voltage or it reproduces in the aerial a state of affairs which in effect truly represents the input speech of the microphone.

It is not necessary to trace here the course of the broadcast programme from the aerial-earth system at the Transmitter to the loud-speaker at the listener's end. It would not be out of place however to give here at the end of this short technical description of the plant installed at the Bombay Station, a few figures about the working of the station. Programmes of considerable variety to the extent of about 2000-2200 a year are being radiated from this Station. Hours of preliminary tests to ensure this programme amount to 400 hours in a year. The average of programme interruption due to failure of power supply, gear trouble etc. has amounted in previous years to about 0.4%.

The equipment of the station is in its seventh year of working. The plant, representing as it does a design of over 10 years ago, has been considered quite obsolete in more fortunate parts of the world and has been replaced by plants of more modern design and it is hoped that the premier city of India will have the latest type of broadcast transmitter installed as soon as the financial situation of the Government of India should warrant a capital expenditure of the order of lakhs of rupees.

THE STATION DIRECTOR.

DEVELOPMENT OF BOMBAY.

The works undertaken by the now defunct Development Department included

(1) The Back Bay Reclamation,
(2) The Industrial Housing Scheme,
(3) Suburban development for residential purposes,
(4) Improved suburban communications, and
(5) Provision of areas outside Bombay for industrial purposes.

There is very little opening up of new land or communications now in progress, but the maintenance of the Development Directorate works and disposal of the land acquired by the Directorate is conducted by the ordinary Government departments.

The total area of land reclaimed in Blocks 1, 2, 5 part, 7 part and 8 is 439·6 acres.

Blocks 1 and 2 comprise areas of 73·19 and 77·57 acres (total 150·76 acres).

The areas in these Blocks together with some old reclaimed land which bring the total area of Blocks I and II to 166·7 acres have been laid out on a plan approved by Government. The areas taken up for roads and recreation grounds are :—

Roads ...	43·5	73·7
Recreation grounds	30·2	

leaving for sale in plots an area of 93 acres. This is divided into 195 plots. Proposal for the leasing of 6 plots measuring about 8,550 square yards and of the value of Rs. 4,82,750 in Block II in front of the Oval, on 99 years renewable leases have been submitted to Government. These six plots all contain Railway land and cannot be handed over to the purchasers until terms have been agreed upon with the Government of India for the Railway strip. The annual ground rent on this area would be Rs. 24,137.

Blocks 3 and 4 have not been reclaimed. In Block 5 the area reclaimed is only about 6.2 acres of which about 4.6 acres are available for sale in plots and the rest is taken up by the road.

The land in this block is divided into 13 plots, which are contiguous to existing properties fronting Colaba Road. Ten of the property-owners have agreed to take 999 years' leases of

the plots in front of their properties, measuring 3.7 acres, on a lump payment of Rs. 4,47, 880 to be paid in instalments in 10 years, 20% of the price being paid in the first year.

Block 6 :–Has not been reclaimed.

Block 7 :–The area reclaimed is 31.3 acres.

Block 8:–Area reclaimed is 251.4 acres.

Of this 234.8 acres have been sold to the Government of India Military Department and 16.6 acres are absorbed in the Marine Drive. The price paid by the Military Department was Rs. 2,06,52,980.

Land in front of Marine Lines Station :-

(Old Reclamation).

The area of this block is 16.3 acres, of which 10 acres are laid out into 16 plots, and the remaining 6.3 acres are to be absorbed in roads.

TOTAL LANDS DISPOSED OF UP TO NOW.

	Square Yards.	Acres.	Annual Ground Rent.	Premium or price.
Block No. 1	Nil	...	...	...
„ 2.				
„ 3	Nil	...	-	...
„ 4	„	...	...	...
„ 5	17,890	3.7	10	4,47,880
„ 6	Nil	...	...	...
„ 7	„	...	...	...
„ 8		234.8	...	2,06,52,980
Old Reclamation (in front of Marine Lines Station).	48.603	10	...	...

Industrial Housing Scheme:—This scheme was undertaken and completed by the Development Directorate and has been in charge of the Collector of Bombay since 1929.

The scheme comprises 207 chawls each containing 80 single roomed tenements for the working classes located in the following four places in Bombay :—

Naigaum	...	42	chawls.
DeLisle Road	...	32	„
Worli	...	121	„
Sewri	...	12	„

A few chawls at Naigaum and DeLisle Road have been converted into two and three roomed tenements.

There are 16,204 rooms and 320 shops available for occupation. Of these 8,149, rooms and 149 shops are occupied at present. Rents range from Rs 5/- a month at Worli to Rs. 8/- at DeLisle Road. There is an annual loss of about Rs. 11,00,000 on the scheme. This loss is partly met from the town duty of rupee one on each bale of raw cotton imported into the City of Bombay and partly from provincial revenues. Tenancies have risen to their present figure gradually from 3180 rooms on 31st March 1925 and show every sign of improving further as soon as normal conditions of trade return.

Suburban Development.— The western trunk road, Bandra-Ghodbunder has been widened and tar macadamed up to Jogeshwari Station on the B. B. and C. I. Railway. In Trombay, the Sion-Trombay Road has been, in some places, widened and improved and the Trombay Section, (Kolwada-Borla Road) has been partly constructed but not yet connected to the Bombay-Matunga road so as to give a direct access to Bombay.

The new railway between Kurla and Chembur has been extended upto Mankhurd (Mani) and platforms have now been constructed at Kurla and Chembur. The central Salsette Tramway which was opened for a short period, has now been definitely abandoned and its site will gradually be disposed of.

The residential and industrial Suburban Schemes are as follows :—

S. S. No. I - Kurla Kirol.—This scheme covers about 590 acres acquired at Kurla to the North west of the Kurla Railway Station. It was intended as a new centre for industries outside Bombay City. Some 31 acres of this area have been transferred to the G. I. P. Railway for car sheds and about an acre sold to a match factory. The remaining area is still undeveloped.

S. S. No. II - Trombay N. E.—This scheme was intended to supply sites for noxious trades such as tanneries and dyeworks and covered an area near Mandala railway station of the Kurla Trombay Railway. The scheme having been abandoned, some of the lands have been withdrawn from acquisition and the others are available for sale in lots. An area of about 9 acres has

been disposed of out of the total area of about 278 acres. These lands are undeveloped.

S. S. No. III–Chembur.—The scheme, comprising an area of about 482 acres, is divided into four sectors viz: Chembur, Pestomsagar, Wadavli and Little Malabar Hill. The greater part of the Chembur sector has been developed while the other sectors are almost undeveloped. About 57 acres have been sold in the Chembur sector mostly to St. Anthony's Society for housing its members. The lands in the other sectors may be sold in an undeveloped condition in suitable lots.

S. S. No. VI—Danda.—The land acquired for this scheme has been partly handed over to the B. B. and C. I. Railway for housing their officers and the rest has been developed as a residential area. In all about 70,000 out of the 80,000 sq. yards of the scheme have been sold and 39 substantial bungalows have been erected. Eleven plots remain for sale. This area is a very attractive one.

S. S. No. VII–Khar.—This scheme, comprising an area of about 8 lakhs square yards, is divided into four sectors viz: sector A reserved for shops and market; sector B, C, and D, reserved for residential purposes. The area sold in this scheme is about 3·5 lakhs sq. yards. The scheme is a self-contained one. It has good railway communications, an electric sub-station and bus service. Land has been allotted to the Bandra Municipality for parking cars near the Khar Railway Station. In all about 347 bungalows have been erected and 87 shops.

S. S. No. VIII–Chapel Road, Bandra.—All the plots in this scheme comprising an area of about 1 lakh sq. yards have been sold and bungalows have been built on most of them.

S. S. No. XV—Ambernath.—This is a scheme for an industrial suburb. The land acquired measures 1510 acres. Of this area about 65 acres have been sold. There is a special water supply and a special electricity supply for the area and it is well served by a train service. The area is well suited for factories, especially those requiring a large water supply.

S. S. No. XVI—Kolekalyan.—So far there has been no development in the scheme, which is situated to the east of the Santa Cruz Railway Station.

S. S. No. XVI–Andheri.— This is a new scheme very near to the Andheri Station to its east. The area is very convenient and accessible and it is anticipated that when development begins it will be rapid.

S. S. No. XVII–C. S. Tramway.— The C. S. Tramway has been abandoned and the land acquired for it is to be disposed of in an undeveloped condition. The land at Kurla near the Kurla Staff Quarters and the Kurla Railway Station will be laid out and sold. There is a scheme for handing over the railway route to the District Local Board for the construction of a through road from Andheri to Wadavli.

S. S. No. XVIII–Kirol North.— This scheme is to the south of the Ghatkopar Railway Station on the G. I. P. Railway. At present this land is mostly undeveloped and is not in demand.

Town Planning Schemes.— In all the following 18 Town Planning Schemes have been completed in the Bombay Suburban District:—

Bandra	Town Planning	I	...	5·68	Approximate area in acres.
,,	,,	II	...	21·82	,,
,,	,,	V	...	1·08	,,
Santa Cruz	,,	1	...	36·71	,,
,,	,,	2	...	145·15	,,
,,	,,	3	...	46·81	,,
,,	,,	4	..	69·96	,,
Vile Parle	,,	1	...	36·49	,,
,,	,,	2	...	86·01	,,
,,	,,	3	...	56·70	,,
,,	,,	4 & 4-A		5·69	,,
,,	,,	6	...	38·21	,,
Andheri	,,	1	...	10·39	,,
,,	,,	2	...	52·64	,,
Malad	,,	1	...	44·73	,,
Borivli	,,	1	...	76·06	,,
,,	,,	2	...	102·62	,,
Ghatkopar	,,	1	...	14·55	,,

E. W. PERRY.

ELECTRIFICATION ON THE G. I. P. RAILWAY.

The whole of the Bombay Suburban Lines have been converted to Electric Running, as well as the Main Line from Bombay as far as Igatpuri in the North East direction and to Poona in the South East direction.

The first stage of the Suburban Electrification was opened from Victoria Terminus via the Harbour Branch to Kurla on the 3rd February 1925 by H. E. The Governor of Bombay, Sir Leslie Wilson; the other stages, to Bandra via the Harbour Branch, to Kurla via the Main Line and thence to Thana being completed and opened at regular intervals, the last section being opened for Electric Service in November 1926. An extension to Kalyan from Thana was put in hand and this was opened for electric running in March 1929, thus completing the Suburban Electrification.

In the meantime, the Main Line Scheme had been sanctioned and work was put in hand. In 1928 the first Electric Locomotives were delivered for trial running, and electrification from Bombay over the Bhore Ghat as far as Poona was completed and officially opened by H. E. The Governor of Bombay, Sir Frederic Sykes, on 5th November 1929; the end of July 1930 saw the completion of the remaining Main Line Section to Igatpuri at the top of the Thull Ghat, and steam working was eliminated on the electrified area from 1st September 1930.

The total single track electrified for Suburban and Main Line Working is 571 miles, and in 1932-33 this dealt with 1865 million ton miles of traffic, which is 17½% of the total traffic handled by the G. I. P. Railway during that period.

For the Suburban lines and the Main lines from Bombay to Kalyan, power is obtained from the Tata Hydro Electric Companies, being supplied to the Railway Substations at Wadi Bunder, Kurla, Thana and Kalyan at 22,000 volts, three phase.

For the Main Lines beyond Kalyan, power is generated at the Railway Power House at Chola, which was specially built for this purpose, and transmitted at 95,000 volts by special transmission lines (of which there are 272 miles of single circuit line), to eleven substations spaced at intervals of about 14 miles, along the routes.

After transforming to a suitable voltage at the substations, conversion from alternating current to direct current takes place there and power is then supplied at 1,500 volts to the locomotives and trains through an overhead line system with a rail return to the substations.

The Power House at Chola is equipped with four 10,000 K. W. turbo generators and condensers, and with six boilers each having a normal evaporative capacity of 60,000 lbs. of water per hour, and overload capacity of 105,000 lbs. per hour, the working pressure being 270 lbs. per sq. in. Cooling water for circulating through the condensers is obtained from the Ulhas River through a specially constructed pump house. In case of failure of the fresh water supply for the boilers, which comes from Ambernath, evaporators have been installed capable of distilling 20,000 lbs. of water per hour from the brackish water drawn from the Ulhas River.

The operation of the Power House has been very satisfactory; reliable and economical results are obtained in spite of the adverse conditions which are experienced in supplying power of a traction load only. These adverse factors are – average low load and severe fluctuations of load; in the case of the G. I. P. Railway system, these fluctuations are accentuated by the effects of regeneration of power by the locomotives when bringing heavy loads down the steep ghat gradients.

A. C. Power at the substations is transformed down from the transmission line voltage (22,000 V. or 95,000 V.) to a suitable pressure for conversion to direct current. Conversion is done in rotary-converter sets which consist of two machines each of 1250 K. W. capacity, the output being direct current at 750 volts. These machines are connected in series to supply the required 1500 volts for the operation of the trains, through automatic overload feeder switches which open in the event of a short circuit on the system.

Six of the eleven Main line Substations are un-attended and are operated by supervisory control from the adjacent attended substations.

The total capacity of the substation rotary converter plant is 100,000 K. W.

For the Suburban services the rolling stock provided consist of 51 single units (each made up of one motor coach and three trailer coaches), and 2 spare motor coaches. Each motor coach is equipped with 4 motors of 275 H. P. each, making a total for the coach of 1,100 H. P., and for a double unit train 2,200 H. P.

A frequent Suburban service is run and fast schedules are maintained, a maximum spread of 53 miles per hour being attained in a number of the sections, 31,000,000 passengers were carried in the past twelve months on these trains.

For the main line services, 24 electric passenger engines and 41 freight engines are provided, displacing altogether 202 steam engines.

Each passenger engine weighs about 100 tons and is equipped with six main motors, giving a total of 2,100 H. P. and able to work a train at a speed of 70 m. p. h., although this is not done as a limiting speed of 65 m. p. h. is imposed as a maximum on the sections worked.

With these engines the passenger services have been considerably speeded up, and, as an example, a special fast return train, the " Deccan Queen " runs daily between Poona and Bombay, doing the distance of 119 miles in 2 hours 45 minutes including three stops and an 18 miles Ghat section with a ruling grade of 1 in 37, on which the speed is limitted to 30 m. p. h. Excluding stopping times and the ghat section, this train runs 101 miles in 2 hours, an average of 50½ miles per hour including starts, various speed limits and stops, and with a maximum limiting speed of 65 m. p. h. This train wall deserves its claim to be the fastest in India.

The freight engines weigh 120 tons each and are equipped with 4 main motors, giving a total of 2600 H. P. The design limits the speed of these engines to 35 m. p. h. and they are capable of working trains up to 2000 tons in weight.

A few of these freight engines are used for assisting trains up the Ghat Sections, (where gradients of 1 in 37 predominate)

the assisting engine being attached to the rear of each passenger or goods train at the foot of the ghat and being detached at the top. Goods trains of 1000 tons each are taken up the ghats in this manner with two engines only, whereas four steam engines were formerly required.

One of the freight engines is also put in front of each descending train on the Ghats, and as this type of engine is desinged for regeneration, the braking effort is produced electrically, by generating power back into the line where it can be used by other trains on the main Line Sections. Trains up to 1600 tons each are handled easily on the Ghats by this method of control.

The maintenance of the electric stock is carried out at specially constructed repair sheds at Kurla and Kalyan, the former dealing with the Suburban stock and the latter with the engines. At each of these places schools are equipped for the purpose of training the drivers with apparatus similar to that on the rolling stock which they will have to work.

Train movements, the supply of electric power to all or any sections, the handling of interruptions and arrangements for making lines dead for working parties on the overhead lines, are watched and controlled continuously from a special office at Victoria Terminus.

It has been possible in the course of this article to mention briefly only a few of the many and complicated items which go to make up a vast electrification scheme such as the G. I. P. Railway possesses, but it is hoped that the few facts which have been put together, will enable the magnitude of the scheme and its accomplishment to be appreciated.

L. A. HOYLE.

THE LIGHTFOOT REFRIGERATION CO. LTD.

The Ice and Oxygen Factories of this Company are situated below the Byculla Bridge alongside the G. I. P. Railway with access from both the Hansraj Lane and Nesbit Road.

Ice Factory.—The Ice Factory is the largest in India.

The original Ice making plant was built in 1912 and was capable of producing 60 tons of Plate Ice daily, but as this

plant was found to be insufficient to meet the growing demand, two further plants of a different design producing 30 and 60 tons Can Ice were installed in 1920, thus increasing the capacity of the plant to 150 tons per day.

The original plant was driven by Diesel oil engines, but owing to extensions these engines were replaced by electrically driven motors with power supplied from the Tata Hydro-Electric Agencies Ltd. The machinery is of the Lightfoot Company's own design and manufacture. The water used in ice making is taken from the Bombay Town Water Supply and is filtered in a quartz sand filter in the Ice Factory before being frozen.

All the latest improvements in the Labour Saving devices have been employed.

The Factory has also been provided with cold stores, where frozen and chilled produce is stored. South African, Australian, American and Japanese apples, pears, grápes etc., are stored in these rooms.

Oxygen Factory. —The Oxygen Factory was erected in 1914. Its present plant, which is in duplicate, is capable of meeting all the requirements of Western India, Iraq, the British East African Protectorates etc.

Oxygen gas is produced by the liquid air process and compressed into solid drawn steel cylinders which comply with all British and Indian Government regulations. These cylinders are also annealed and tested at regular intervals.

The Oxygen plants are electrically driven.

To demonstrate the use of oxygen in connection with welding and metal cutting work a special staff of welders is maintained. Oxy-acetylene welding and cutting work is also executed and suitable men are trained for clients who purchase welding or cutting plants.

For medical purposes the Company supplies oxygen gas of high purity which is proved most valuable and considerable use has been made of this gas by the medical profession in recent years.

The Company has recently started to put liquid oxygen on the market as an explosive for blasting purposes. The cellu-

lose cartridges are soaked in liquid oxygen and used as explosives, and these have been found to be much safer and cheaper than any other blasting materials.

S. BHAWANIRAO.

BOMBAY MUNICIPAL FIRE BRIGADE.

The Bombay Municipal Fire Brigade is maintained from the revenue derived from a special Fire Tax levied at a half percentum on all rateable property within the Island of Bombay and therefore, its services to the public are free.

As an organisation it dates back a long way, and before being taken over by the Municipality it was administered by the Commissioner of Police, the officers and men being members of the ordinary police force. The European members of the Brigade performed police duties as well as fire duties, but the Indian members were restricted to the work of the Brigade only.

In 1864 a commission appointed reported that the Brigade was under-manned and under-equipped, and in 1865 a European was sent to England to qualify himself for the post of Captain of the Fire Brigade, and an Ex-Commissioner of Police was appointed to re-organise the existing system.

In 1887 the authorities were forced to relieve the European police officers attached to the Brigade of all police duties owing to the rapid growth of the City. At that time there were only four steam fire-engines and eight manual engines.

In 1889 the Municipal Corporation appointed a committee to consider the subject of re-organising the staff, and as a result an officer from the London Fire Brigade was appointed as Chief Officer in 1890. Under this officer's supervision a great measure of reform was effected. The Brigade was then modelled on the lines of the London Fire Brigade, and soon assumed the full status of a modern fire brigade. A strict working code was adopted, the staff were trained continually, and uniforms were provided.

In 1907 the first petrol motor fire-engine to come east of Suez was placed into commission in Bombay, and from that time the horse steam fire-engine gradually made way for the petrol motor fire-engine.

The strength of the Brigade at present is 14 officers and 290 other ranks, and the equipment comprises 12 motor pumps (all fitted with first aid water apparatus), 4 motor steamers, 2 motor escape and ladder tenders, 1–82 feet and 1–85 feet motor turntable fire escapes, 1 motor rescue and emergency van, 2 general service motor lorries, 1 motor car, 5–50 feet fire escapes, 4–60 feet fire escapes, 4–35 feet extension ladders, 2-12 feet hook ladders, 12 hose reels, 4 smoke helmets, 4 sets of breathing apparatus, 3 oxy-acetylene cutting plants, 1 foam generator and 40,000 feet of rubber-lined canvas fire hose.

There are 10 fire stations to which are connected 179 street fire alarm posts distributed throughout the Island. During the year 1932–33 sixty three per cent. of the total number of calls were given through the fire alarm system which is tested daily by the Brigade staff, and maintained by a special staff of the Bombay Telephone Company.

The firemen are always kept on the alert by surprise drill calls, and a new man soon learns to keep himself ready for immediate response to any call.

Not only does the Brigade attend fire calls but is expected to answer almost any emergency call. Sometimes it is to a collapse of a building in which persons may have been trapped, to a jammed lift, to an animal fallen down a well, to a motor accident, to a maniac who has climbed a post and refuses to come down, or to a toddy drawer who has become too ill or frightened in a high wind to descend from his lofty perch.

The Brigade also administers an accident ambulance service consisting of five motor ambulance cars which are manned by firemen holding first-aid-to-injured certificates. These ambulances like the fire engines are kept ready for instant response to emergency calls. Approximately seventy five per cent. of the Brigade staff are qualified in "First Aid."

N. Coombs

CONSERVANCY WORK IN BOMBAY.

The area of the City is 15,480,29 acres or 24.19 Sq. miles. The population (Census 1931) is 1,161,383. The inhabited houses in 1931 are 47,045. Mean density per acre is 75. The death rate for 1932 per thousand is 19·7 by the Census population of 1931.

Removal :—The work of the cleansing branch is conducted by the Head supervisor under the control of the Executive Health Officer. For administrative purposes the City is divided into three divisions, each under the charge of a Supervisor. These divisions are further sub-divided into 10 districts each under the charge of an Assistant Supervisor. These 10 districts are divided into 50 sections, each under the charge of an Overseer who takes his orders from the Assistant Supervisor of the district to which the section belongs.

The collection of the refuse is all carried out during the day.

Sanitary bins of standard size and pattern are now being insisted upon by the Municipal Commissioner on all house-owners for the storage of house refuse pending removal by the Cleansing Branch. 30,000 bins are in use at present and they are emptied out daily.

Mechanical Transport :—Of late Mechanical Transport has been making great headway and is rapidly displacing bullock-carts for Municipal and Public Works. It is only therefore a matter of time before the more primitive method becomes entirely obsolete.

With further adoption of mechanical transport for the removal of the city's refuse the system at present in vogue in Bombay during this transition period, necessitates the continuance of refuse dumps where the refuse, which had been collected by bullock-carts, is deposited and removed therefrom by means of 4–5 ton motor lorries. At present the motor lorries are loaded at the dumps by manual labour but the question of carrying out this work by means of mechanical loaders is under consideration and is likely to be adopted. The dimensions of these lorries are 11′-7″ long by 6′-4″ broad by 3′-4″ high. Work is carried out in two shifts – the first shift being from 6 A. M. to 2 P. M. and the second from 2 P. M. to 10 P. M. The average cost of working the lorries for the year 1931–32 was 12 annas 8 pies per mile. This is inclusive of all charges such as depreciation, inspection, license fees, repairs, drivers, oil, petrol, etc.

The aim of the Bombay Municipality is to eventually adopt throughout the city the system of house-to-house collection of refuse. With this object in view different types of motor transport are being tried from time to time.

A 3 – ton Vulcan motor vehicle manufactured by the Company of that name at Crossens, Southport, England has been in use for some years. This vehicle has a small engine which is economical in working and does about 15 miles per gallon. The dimensions of the body are 13′-7″ long by 6′-10″ broad by 2′-3″ high; whilst the loading height of the body from the ground is only 4′-2″. This enables the bin-man to deposit the refuse into the lorry quite easily without the assistance of a second man. These vehicles are comparatively low in intial cost and maintenance and being successful in meeting local conditions are likely to be adopted very extensively in India for this type of work. The cost for this vehicle averages 7 annas 4 pies per mile.

As a substitute for standing carts in one district of the city it was considered that the removal of refuse can be carried out more expeditiously if large circular bins roughly 3′ diameter, 2′-9″ high are placed in suitable positions for the reception of refuse. These bins or receptacles are fitted with a handle by means of which they can be attached to the hook of a crane with which some of the Leyland lorries are specially fitted. This enables the contents of the bins to be rapidly emptied into the body of the vehicle, the empty bins being immediately returned to their site. This system has proved successful as it permits of the receptacles being emptied more frequently than was the case, when carts were in use. The crane on the lorry is actuated by means of a chain drive from the gear box. In Calcutta this system is extensively employed.

In 1928 a trial was given to the Tractor and Trailer system whereby suitable trailers of steel construction and having a carrying capacity of 3 tons were drawn by bullocks from house to house. After being fully loaded the trailers were taken to side lanes where the tractor called and drew the trailers either to the dumping ground or the refuse Railway Siding. Although this system at first appeared to have certain advantages, its lack of flexibility and slowness of travel together with high working cost rendered it less suitable for the purpose when the travelling distance exceeded 2 miles, than the low-sided motor vehicle. For distances of 2 miles and under, the Tractor-Trailer system has been found to be both efficient and economical.

Leyland Steam lorries for refuse collection were first introduced in Bombay during the year 1911. Six of these lorries worked successfully till about 1922 when Leyland petrol motor vehicles of 4–5 ton capacity were standardized in order to ensure interchangeability of parts and to reduce the cost of repairs and maintenance.

The removal of road scrapings is carried out by means of 4-5 tons lorries fitted with steel bodies and hydraulic tipping gear. The scrapings are thus emptied automatically. This gear is very reliable and should always be fitted when required, as by this method, emptying of the lorries is expeditiously and economically carried out.

The fleet in charge of the Conservancy Branch consists of:—

20 Lorries, 2 Crane Lorries, 4 Road Scraping Lorries,
15 Tractors with 30 Trailers.

Bullock Carts.—There are 800 Scavenging carts with capacities ranging between 30–40 cubic feet and capable of taking 8 cwts. to ½ ton of refuse each and 150 iron carts for silt and mud of 29 cubic feet capacity each. These are all in use.

The total amount of refuse collected (including street and gully sweeping) approximates 1,040 tons per day.

This gives a weight of 16 cwts. of refuse per 1,000 of population per day or 292 tons per annum or 1·8 lbs. per head per day. or 5·9 cwts. per annum.

Trade wastes including refuse from licensed stables brought by private agency for disposal amount to an avarage of 233 tons per day. This added to the above figures work out at 2·2 lbs. per day per head of population or 19·6 cwts. per 1,000 of population per day or 387·7 tons per annum.

There are two collection yards, one at Palton Road and the other at Parbadevi receiving on an avarage 500 and 140 cartloads of refuse daily.

The refuse from these collection yards is loaded into petrol driven lorries and hauled to the Mahaluxmi Siding where they are unloaded into the Railway wagons and the refuse conveyed to the marshy lands at Deonar, which is being reclaimed. Deonar is 7 miles away from the city limits. Carts working outside

the collection area pertaining to the two yards go direct to Mahaluxmi Siding, excepting about 10 in the extreme northern portion of the island. These latter dump their contents at the Dharavi Reclamation Ground.

Street Cleansing, Washing and Scraping.—The City has approximately 215 miles of streets with a total square area of 67,34,506 square yards which has to be cleansed twice a day. Of these, 8,53,237 square yards are of asphalt, 1,26,046 square yards of set-stone pavement, 1,75,853 square yards of tar macadam, 16,130 square yards of other modes of concrete construction, and the rest of the road area is water bound. In addition, 5,494 house gullies or sweepers' passages with an aggregate area of 3,29,623 square yards have also to be cleansed both morning and evening.

Street cleansing is carried out on the "Beat" principle. Each street scavenger has a definite area of street to cover, together with the number of gullies abutting thereon. In one of the Wards, the "Beat" principle does not prevail but the "Gang" principle is adopted. Here gangs of 5 or 6 men carry out the cleansing work. Under both systems sweepings are collected into small heaps at intervals of 20 to 30 feet along the sides of roads and at gully entrances, which collections are picked up by a cart following behind, scavenger women carrying out the work of lifting up the collected heaps in their baskets and emptying them into the carts referred to above and in the absence of the travelling cart into stand-by carts.

The surface of the city streets and roads are being gradually asphalted and the introduction of mechanical sweepers, collectors and road-washers is essential. Sweeping and collection of refuse by mechanical means, means always higher speed resulting in a proportionate increase in the mileage of streets swept. Furthermore the work done would be more effective and economical than that by manual sweeping and collection. These machines would be a real asset to the Health Department.

In order to deal with the daily fouling of the streets with horse droppings and cow-dung, street orderlies (boys) with galvanized iron hand receptacles are employed. The contents of the receptacles are dumped at convenient spots from which they are subsequently taken to the tips by carts.

Hand barrows are used in some places where large quantities of heavy refuse are collected in small areas and have to be taken to distant stands.

50 orderly bins have been provided on footpaths for light street refuse and paper. They are emptied twice daily by travelling carts.

Notwithstanding the frequency of the sweeping of the streets in the shopping centres, the littering continues. The defect is not in the cleansing work but in the habits of some of the people who thoughtlessly throw down litter or anything away in the street as soon as it is no longer required. A street freshly cleansed by the staff is often made untidy a few minutes later by careless pedestrians.

Similar conditions obtaining in England are effectively met by the local authorities by the enforcement of Bye-laws. The London and Middlesex County Boroughs have the following Bye-laws:—

" No person shall (1) sweep or otherwise remove from any shop or house into any street any waste, papers, shavings, or other refuse or being a coster-monger, news-vendor or other street trader, throw down and leave in any street any waste paper, shavings or other refuse ; (2) throw down or leave in any street for the purpose of advertising, any bill, placard, or other substance ; (3) wilfully or negligently suffer any straw, hay, waste paper, shavings or other litter from any vehicle, packing case, to be strewn about any street to the annoyance of the residents or passengers."

The principal roads and streets in each area are swept 3 to 4 times daily and the very important ones continuously. The less important thoroughfares are attended to twice daily.

In addition to this cleansing, squads of men and women are out, washing off the asphalted roads in various parts of the city or removing dust and mud collection; the former operation being more extensive in character during the eight dry months of the year and the latter during the four wet months.

Washing work is a necessity nowadays and more efficient work could be obtained by the employment of washing machines

the water being applied to the surfaces under pressure. More speedy work is possible without diminishing the effectiveness of the cleansing work and at the same time the results from the work of these machines, would be more economical than those by manual labour.

Gangs of men are employed for flushing out gullies, an operation which continues throughout the year.

A special staff is slso employed for the daily cleansing out of all gully-traps in connection with house-drainage and for removing obstructions in the latter, should occasion require it.

Disposal.—The annual amount of refuse including street sweepings received for disposal through Municipal Agency is 3,79,600 tons, and that delivered by Traders 85,045 tons or a total of 4,64,645 tons.

In so far as the desposal of refuse is concerned the systems at present in operation are three in number, namely, (*a*) by rail to reclamation grounds at Deonar, (*b*) by dumping into the low lying lands in the city (crude tipping), (*c*) by maturing dung in pits into manure.

(*a*) By Rail to Deonar Marshy Grounds :—The Municipal Rolling stock consists of 173 Railway wagons, of which on an average 60 are brought into daily use for hauling refuse to Deonar.

Two trains each with about 30 wagons run daily, one at 9–30 a. m. and the other at 10 p. m. A train of 30 empty wagons is kept at Deonar.

The daily amount of refuse transported to Deonar is 780 tons or 2,84,700 tons per year.

The Deonar estate comprises a total of 823 acres.

The total area reclaimed so far at Deonar with city refuse approximates 270 acres the depths varying from 6 to 15 feet, this leaves a balance of 553 acres of the estate still to be reclaimed. This reclaimed area is given out on rent to farmers each year for cultivation. The annual income derived from such letting is between Rs. 8,000 to Rs. 10,000.

(b) By dumping into low lying parts of the city :—

The low-lying lands owned by the Municipality situated between the Haines Road Hindu Cemetery and the Race Course are available for the purpose. About 500 tons on an average are daily being deposited into this low-lying land or 1,82,500 tons per year.

There is yet another ground rented from the City Improvement Trust at Dharavi which is being reclaimed; about 15 tons are daily deposited here by carts plying in the extreme northern portion of the city or 4,575 tons per year.

The area of land already reclaimed within the city limits in the past admeasures 316 acres which is annually leased for cultivation and the amount realised each year ranges between Rs. 10,000 to 12,000. The land is put up to auction and with facilities for transit fetches these prices.

The land is prepared in May and, on the first appearance of the rains, maize, cucumber and gourd are planted – all in the same field in rows. When these crops are well established in July or August, brinjals and beans are planted amongst them. The maize is collected from the plants and the stalks are beaten down and form a frame for the gourd and cucumber; vegetables and spinach are then planted and this is carried on until March.

English Name.	*Marathi Name*
Maize or Indian Corn	Kanas.
Cucumber	Kakadi.
Gourd	Shiroli.
Brinjal	Wangi.
Legume	Gowar.
Spinach	Bhaji.

(c) By maturing dung in manure pits :—

The Manure or Dung Pits. — All dung from milch cattle stables is being deposited into these pits which are 4 in number. During the months of January to May and October to December in each year, the average daily number of cart-loads of dung dumped into these pits is 32 and in the months of June to September the average is 77.

The annual amount of dung received into the dung-pits on an average is 12,900 cart-loads or 6,500 tons. This makes about 5,900 tons of manure.

The right of selling manure is annually sold out to contractors. The amount realised each year from such sales ranges between Rs. 2,500 to Rs. 3,500.

The Municipality also undertakes the transporting of carcasses of dead aninals to Deonar in wagons attached to the refuse train which leaves at 10 p. m. Average number of dead animals transported per year is 27000 (this figure is exclusive of the number of dogs and cats). There is a skinning ground established there. The right of skinning is auctioned annually to contractors and the amount realised each yea ranges between Rs. 30,000 to Rs. 50,000.

The number of carcasses transported per year averages 3,385 of big animals such as cows, buffaloes, horses, and 23,784 smaller sized animals such as calves, goats and kids.

The carcasses of dogs, cats and others which the contractor does not skin are thrown to the vultures.

Staff:–In all 4,684 men, 1,487 women, 50 boys and 434 drivers are employed on the operations in connection with the Cleansing Branch, besides the Superintending and Clerical staffs.

House accommodation for the Labour Staff of the Conservancy Branch consists of 127 blocks with a total of 3,180 rooms. The majority are owned by the Corporation and a few hired. This accommodation houses 6,000 employees, and further proposals are before the authorities for housing the remaining.

The problem of finding an efficient and economical system of disposal of refuse is one of the most difficult ones.

In the western countries many methods are employed, each claiming efficiency and economy but the fact remains that the selection of a process can only be made with due regard to the local surroundings. It is only by careful and serious study of local circumstances assisted by scientific analysis of the character of the refuse, can one formulate and prepare schemes of refuse disposal suitable to local conditions.

J. S. NERURKER.
C. DEJOSS.

THE SWADESHI ELECTRIC CLOCK MANUFACTURING COMPANY.

This concern was started five years ago, by the life-members of an Educational Institution—The Tilak Pathshala of Nipani, a town in the Karnatak. The Institution wanted to open a Technical branch in the school and so deputed one of its life-members to Poona for higher Technical Education. While considering about the Syllabus to be adopted for this Technical branch, it was thought more advisable to attempt some new industry than to take school-students through the usual routine course of turning and filing. It was decided to begin the experimental work of constructing electric clocks in Bombay—the only place convenient for such Technical experiments.

After a year's labour attempts in making electric clocks of the Master-secondary system were successful. Shortly after that, with the help of some sympathisers, this new enterprise was started in a small room in the Shastri Hall at premises Grant Road, on the 3rd of February, 1929. By the end of the first year, the works were transfered to the present place–a more spacious shed, specially erected for the purpose by Sardar Patwardhan, the owner of the Shastri Hall premises.

The concern began with the making of clocks of the Master-secondary system and has by this time perfected and installed a number of designs, from small wall clocks to big Tower clocks. The Company has put up clocks throughout India, in big cities like Calcutta, Agra, Karachi, Ahmedabad, Bombay and others, and has won high reputation by the satisfactory quality and service of its production. The latest undertaking is the electrification of the clock for the Rajabai Tower of the Bombay University, which is to be the largest clock in India, the diameter of each of the four dials being 13′–6″.

What little the Institution has achieved so far is merely the underground work of this new Industry. The erection of the main structure is yet to begin, which to a large extent depends on the encouragement, the institution would receive at this time. The concern is being conducted as an Educational Institution at great self-sacrifice, none of the engineers and other members of the staff receiving more than Rs. 25 per month.

It is a unique business institution in the country and claims to be the only one of its kind so far.

The concern had to do a great deal of experimental research for improving the quality of its products and endeavour incessantly in securing suitable market for the same. In spite of all these difficulties, the achievements of the concern have been remarkable, which undoubtedly is due to the exceptional technical insight of Mr. M. D. Joshi, the principal engineer of the institution.

The concern began with the production of electric clocks only, but later undertook to construct mechanical clocks and installed some big mechanical and striking clocks in several places. The company's attention was concentrated on the production and perfection of Tower and Frontage clocks, both electric and mechanical, with striking, chiming, and carrilon attachments. It can be asserted that as far as Tower clocks, are concerned, this infant concern can now make Tower clocks, of any size and specification. Small spring clocks and timepieces also are now being attempted and it is expected that the Company will be able to place in the market small time-pieces (spring-driven) in a short time.

CUSTOMS CHEMICAL LABORATORY.

The Chemical Laboratory attached to the Bombay Customs is located in the 2nd floor of the New Custom House. It is a comparatively new institution. It was started only in 1929.

Formerly all analyses required by the local Customs authorities were made by the Chemical Analyser to the Government of Bombay. In 1926, in view of the steadily increasing volume of Customs work, and for reasons of administrative convenience, the Government of India (Central Board of Revenue) decided to have departmental laboratories at each of the major ports. In Bombay, however, the planning and equipment of the laboratory were taken up only in September 1928, and the laboratory started working in April 1929.

This is a laboratory intended to deal with the work of Customs and Salt Departments only. The samples examined cover a large range of products, raw, partly or wholly manufactured. Most of the work is for revenue purposes, to assist in the proper

classification and correct assessment of imported materials. This, however, is not all. A large amount of work is done under the Merchandise Marks Act, (in the interests of consumers in general) to prevent misdeclaration of articles, and to prevent the passing off of inferior products as genuine or high grade ones. Much work is also done under the Dangerous Drugs Convention of the League of Nations. The Indian Explosives Act and the Indian Petroleum Act, which prohibit the importation of certain dangerous products, or require special licences for certain classes of goods, account for still another line.

The Laboratory has also to study and devise new methods of test in order to meet the wide variety of articles that come for examination, particularly the products of recent scientific and technical developments.

The Laboratory is suitably equipped to handle with the least possible delay, the large variety of products like drugs' medicines, spirits, essential oils, paper, dyes, textiles etc. There is also a good reference library to which additions are made every year.

On an average about 10,000 samples are examined every year, and the Chemical Examiner is assisted in the work by a staff of five trained chemists.

S. S. AIYAR.

BOMBAY AND THE INDIAN FILM INDUSTRY.

In the film industry of India, Bombay happens to be the most important centre. It was in Bombay that the first successful feature film in India was produced. It was in Bombay that the first Indian talkie was recorded and it was in Bombay that the first Indian multi-colour film was exhibited. Bombay is, therefore, naturally the head-quarters of the Motion Picture Society of India which is the only organised body connected with this industry.

The first feature film produced in India, (in Bombay), was called " Harischandra " and was made by Mr. D. G. Phalke in the year 1913. The immediate success which attended this venture attracted the attention of other Indian producers. Capital began to flow into this new channel and a thriving industry was soon established in and around Bombay. To-day

it is perhaps the most important local industry, second only to the manufacture of textiles in the city.

The first Indian talkie " Alam-Ara " was produced and exhibited in Bombay in March 1931. Between the years 1913-31 a number of producing centres sprang into existence all over India, the most important among which were Calcutta, and Kolhapur (Bombay presidency). After the advent of talkies considerable expansion of the industry has taken place. Many more producing centres like Poona, Madras, Delhi and Lahore are in the making. In Bombay city proper and the presidency, according to the lastest figures, there are 36 film producers, 21 distributors, both Indian and foreign, 146 cinema houses and 29 travelling cinemas. The talkies have ushered in a new era in the life of the film industry. Production methods have been completely revolutionised and here again Bombay gave the lead. The possibilities of the multi-coloured film as indicated by the production and exhibition of " Sairandhri " are unforeseen. It does not seem probable at least in the near future, that the position of the leadership which this city enjoys can easily be assailed by any other producing centre in India.

Talkie production (silent production being almost extinct by now) is a highly developed technical industry. It requires a large initial capital outlay, a set of skilled artists and a number of experienced technicians. Bombay, besides possessing all these, enjoys a number of other advantages in addition. It has the largest industrial population in India and as elsewhere, here also the industrial population happens to have the most developed cinema habit. A picture produced in Bombay has, therefore, the biggest local market in India, being immediately available and the reception a picture gets in Bombay settles its fate more or less in other parts of the country.

Raw materials and machinery required for the production and exhibition of a film have all to be imported. Bombay's fine port as well as other advantages as an established importing centre have favoured the city in the development of this new industry. Out of a total footage of 2,55,75,887 of raw films imported into India in 1932-33, Bombay alone claimed 2,15,76,215, which is about 84·35%. Almost all Indian and foreign

distributing firms of exposed and un-exposed (raw) films maintain their head-offices in Bombay.

In order to promote and guide the growth of this industry the Motion Picture Society of India was started in Bombay early in the year 1932. During the short period of its existence it has tried to educate the public on the importance and needs of Indian films and to impress upon the Government the necessity of a co-ordinated cinema policy for the country. The Society maintains a Technical Sub-committee to advise its members on all technical matters connected with the industry. Its future programme includes the establishment of a central library and a laboratory for the use of the public and particularly the members of the Society. Further, the Society cherishes the ambition of establishsng a technical institute for the training of students for the various branches of this industry and it naturally looks up to the Bombay University and the Bombay Government for help, financial and otherwise. As Bombay has taken the lead in this industry since its earliest development it is to be hoped that it will continue the tradition of leadership by helping to make the dream of such an institute a reality.

A personal visit to some of the local studios will prove interesting and educative.

K. S. HIRLEKAR.

EXCURSIONS.

Bandra.—Bandra is situated on a promontory in the south-west corner of the island of Salsette and lies a little beyond Mahim to which it is connected by the Lady Jamsetji Causeway (See Map). Bandra Hill and the adjoining Pali Hill, where there are Golf links are favourite places of resort for the citizens of Bombay, and can be reached either by a motor car through the Mahim Woods or by train to Bandra Station on the B.B. & C.I. Railway. Hack victorias, taxis and buses can be obtained at Bandra Station. Near the railway station and the north end of the Causeway is the Bombay Municipal Slaughter House. In the days of the Portuguese, the Jesuit College of St. Anne stood upon the spot and it was described as "not inferior as to the building nor much unlike those of our Universities of Oxford and Cambridge." The road to Bandra divides at the foot of the hill and here near the seaside is the Church of St. Andrew

built by the Jesuits in 1570. A large Cross stands in the compound of this church, and it is said that it originally belonged to the Church of St. Anne. ·On the top of Bandra Hill is the Church of the Lady of the Mount, conspicuous by its two high spires; close by is the. English Church, St. Stephens. At the extreme point of Bandra are the ruins of an old block-house erected by the Portuguese in 1640.

Elephanta.—This is an island in the harbour about 6 miles to the east of Bombay and about 4 miles from the mainland of Konkan. It is called Elephanta, because near the former landing place on the south side of the island stood, in olden times, a large stone elephant. "Pyke in 1812· and Anquetil du Perron in 1760 represented the elephant as having another smaller one on its back. In 1764 Niebuhr reported that there were remains of something on the back but that it was impossible to distinguish what it was." Basil Hall conjectured that the "smaller animal" was a tiger. It is, however, most probable that it was an "*Ambari*" or a canopied howdah. "In 1814 the head and neck of the elephant dropped off and the body which had a large crack down the back sank down." It eventually fell to pieces. "Sometime about 1864 the Government of Bombay entrusted the conservation of the caves to an official of the Public Works Department, an Engineer, with whom as with engineers universally, 'nothing is sacred', who forthwith proposed to clear out this profoundly interesting heap of stones and break them up into road metal." The broken pieces however were brought to Bombay through the exertions of Sir George Birdwood and deposited in the Victoria Gardens, where they remained as a shapeless mass for a long time. A few years ago these pieces have been put together, and the "restored" elephant now stands again near the Victoria and Albert Museum, minus however the "something" on the back. Old travellers also state that at a little distance from the elephant, where the two hills approach each other, stood a stone horse, which an early writer described as being "so lively, with such a colour and carriage and the shape finish with that exactness that many have rather fancied it, at a distance a living animal than only a bare representation." When Freyer saw it in 1673 it "had sunk into the earth up to the belly". Alexander Hamilton saw

it there in 1718 but thought it was "not so proportionable or well-shaped as the elephant." It had disappeared by 1784.

The local name for Elephanta is "Gharapuri" said to be a corruption of Mangalapuri, the 'Grihapuri' or headquarters of the Maurya Dynasty. Traces of this city are still to be found near the northern landing place in the form of broken pillars, brick and stone foundations and fallen statues of Shiva.

The modern landing pier is at the north-west side of the island; the paved ascent which leads from it to the caves was constructed by Karamsi Ranmal, a Lohana merchant of Bombay, in 1853.

The caves which are of Brahmanical origin, are dedicated to Shiva; they are situated at an elevation of about 250 feet above the high-water level and are entirely hewn out of a hard compact variety of trap rock. The whole excavation consist of three parts; a central temple or the Great Cave, with a smaller chapel on each side. The Great Cave measures about 133 feet from side to side and is of about the same size from front to back. The flat roof was originally supported by 26 carved columns with 16 half columns, but many of these pillars have been either damaged or destroyed. The west side of the cave is occupied by the Shrine proper and the various compartments of walls between the pillars are carved with sculptures representing scenes from the Hindu Mythology.

The Shrine is a square chapel with four doors and contains the *Linga* which represents "Shiva in his character of the prolific power of nature." Around this linga chapel are a number of large figures representing Dwarapalas or door-keepers. Of the various sculptures on the walls the most striking is the colossal "Trimurti". It is situated at the back of the cave and faces the entrance. It represents Shiva in his three-fold character: Brahma, the Creator occupies the centre of the figure; Vishnu, the preserver is to his left holding a full-blown lotus in his hand; and Rudra, the destroyer to his right, holding a cobra. "In 1865 this unique bust was destroyed by some barbarian clothed in the garb of civilization, who broke off a portion of the noses of two of the faces: and since then some of the other sculptures in the temple have been similarly treated, so that it

has been found necessary to place a Sergeant and two native policemen to guard the cave, "

The other sculptures represent " Ardhanaree shwara " or Shiva as uniting the two sexes in his person; Shiva and Parvati; Mount Kailasa, Ravana shaking Mount Kailasa; Tandava Dance; Bhairava; and Shiva as an Ascetic.

Of the two small chapels at the sides, the one to the east contains a small "Linga" with steps leading to it guarded by two sculptured lions; while the small chapel to the west contains a reservoir for water and is also dedicated to Shiva. There are also other caves in the neighbourhood; but they are in a more or less dilapidated condition.

No data are available for fixing the precise date of excavation of these caves. An inscription stone which existed over the entrance was removed about the year 1540 by Dom Joao de Castro, the Viceroy, and sent to D. John III, King of Portugal; but no one now knows what has become of this valuable relic.

The flora of Elephanta is practically the same as that of the jungles of Salsette. As regards the fauna, Hamilton (1718) states that when he fired a gun in one of the caves " a serpent 15 feet long and two foot about gave him chase and made him take to his heels, " but no such denizens are met with there now. The golden or tortoise beetle (*Aspidomorpha sanctæ-crucis*) and the green bug, *Chrysooris stockerus* are common on the island.

Kanheri (Kennery) Caves.—These caves are situated in a wild and picturesque valley in the heart of the island of Salsette and may be reached from Borivli Station on the B. B. & C. I. Railway from which there is a road to within a mile of the caves. The name Kanheri is a corruption of " Kanhagiri " which in turn is a Prakrit corruption of Krishnagiri, *i.e.*, Krishna's Hill, and it is conjectured from this that the fame of the hill for sanctity must have dated from before the rise of Buddhism.

The caves are Buddhistic and number over one hundred. An inscription in the caves at Nasik has led archæologists to suppose that they were constructed between 100 B. C. and 50 A. D., but apparently some fresh caves were excavated subsequently, during

the fourth, fifth and sixth centuries. Bishop Heber has remarked that "the beautiful situation of these caves, their elegant carving and their marked connection with Buddha and his religion render them every way remarkable." The caves consist of numerous dwellings for Buddhist monks, and some "Chaityas" or relic-shrines. Of the latter the large "Chaitya cave," sometimes also called the "Cathedral cave," is the most important. In front of it once stood three relic mounds which Fergusson thought were more ancient than the cave itself. They were probably the chief objects of veneration, and the great cave was subsequently excavated near them by some devotees. The largest of these mounds was between twelve and sixteen feet in height, and built of stone and brick. Dr. Bird opened it in 1839 and found therein two copper-plates and "a circular stone hollow in the centre and covered at the top by a piece of gypsum." The copper-plates had the Buddhist creed inscribed thereon, while the stone coffer contained two small copper urns in one of which were ashes with a ruby, a pearl and a small piece of gold; there was also a small gold box containing a piece of cloth. The other urn contained a silver box and ashes. The vestibule of the great cave contains two gigantic figures of Buddha 23 feet high. The next important cave is the "Durbar Cave" distinguished by "two long low seats or benches running down the whole length of the centre." It was a place of assembly and a hall of audience. The "Vihars" or the Monks' dwelling caves are scattered all over the hill in the neighbourhood at different levels, and the remains of an old dam which at one time formed a large reservoir are still visible. These caves did not escape the religious zeal of the Portuguese. About the year 1535 Fr. Antonio, a Franciscan friar, forcibly converted the Buddhist ascetics and "turned the great *Chaitya* cave into a Christian Church of St. Michael and it was used as such until after the fall of Bassein." Anquetil du Perron states that it was still used by the Christians in 1760.

Vehar and Tulsi Lakes.—These can be got at most easily by a motor car *via* Vincent Road. This road passes through Sion village and near Sion Railway Station joins an excellent new road running along the west side of the G. I. P. Railway line. The old Duncan's causeway, which passes through the narrow and crowded Kurla Bazaar, should be avoided.

The new road, however, has its drawbacks. Beyond Kurla the road passes through a hilly district. The Powai lake lies to the right and the road to it passes through an old gateway; Vehar Lake lies further north. The leakage water from these lakes was at one time utilised for the cultivation of *Agave americana* on a large scale, but owing to prevalence of malaria among the plantation labourers, the project had to be given up. The last portion of the road to Vehar goes up a steep hill. A monument just within the entrance gate records the services of Captain Crawford who was the author of the Vehar Water-works scheme; at the other end of the embankment is a small Dak bungalow owned by the Bombay Municipality. To the north of Vehar is the lake of Tulsi; and further north still among the hills lie the caves of Kanheri. The Vehar and Tulsi lakes yield a daily supply of $9\frac{1}{2}$ and $4\frac{1}{2}$ million gallons of water respectively. The return journey may be made through Powai grounds. The scenery near this lake, especially during the monsoon is extremely pretty; the road through the Powai estate runs by the side of the lake and ultimately joins the Thana-Kurla road.

Ghodbundar and Thana.—This excursion is interesting from an archæological as well as an artistic point of veiw, and should be made in a motor car through Mahim. In the southern part of the Mahim Woods stands the Hindoo temple of *Prabhadevi* the family goddess of Raja Bimb of Mahim. The original temple was destroyed when Mahim was taken by the Mahomedans, but was re-built in 1714. Further north among the palm trees stands the Roman Catholic Church of *N. S. da Salvacao*, and at the end of the Lady Jamsetji road near the causeway, to the right, lies the church of *San Miguel.* These two Churches belong to the period when this part of the island was given by the Portuguese Government free of rent to the various Roman Catholic religious orders. On the opposite side of the road stands the old *Mahim Fort* and a little to the south of it is the fifteenth century *Shrine* of the Muhammadan Pir Sheikh Makhtum Shah. After the creek is crossed to the right will be seen the *Slaughter House* where once stood the Jesuit College of St. Anne; further on is the Bandra Station. The road next passes through *Santa Cruz*, *Vile Parle*, and *Andheri*; these places have only lately become studded with little villas, chiefly built by the citizens of Bombay

since the days of plague. A little beyond Andheri to the right is the *Jogeshwari Cave* which is the third largest Brahmanical cave in India, being 240 feet long and 200 feet broad. It dates from the 7th century and "contains rock cut passages, an immense central hall supported by pillars, porticos and subsidiary courts." The road then passes on to *Borivli* which is "a convenient centre for visiting the several places of interest which exist in this neighbourhood." The *Kanheri Caves* lie up the Tulsi valley about 5 miles to the east. At *Mandapeshwar*, called Mompezier or Mompacer by the Portujuese, about a mile to the north of Borivli, are situated a notable white Portuguese tower and a set of Brahmanic caves over a thousand years old, one of the latter being specially interesting from having been used as a Catholic Chapel. On the top of the rock in which the caves are cut stands a large and high-roofed Portuguese Cathedral, lately repaired, and extensive ruined buildings, belonging to a college and monastery. In a Mango-orchard called Maniparla wadi at *Eksar* in rich wooded country, about a mile north-west of Borivli are some great blocks of stone about 10 feet high by 3 feet broad. They are memorial stones richly carved with belts of small figures, the record of sea and land fights probably of the eleventh and twelfth centuries. About half a mile to the east of Borivli station close to the borders of Poinsar, and the deserted village of *Magathan* are some Buddhist rock-cut cisterns and some half-underground Buddhist caves. A few hundred yards to the east lie some Buddhist tombs and the remains of a Buddhist monastery, of the fifth or sixth century. At *Akurli* about 2 miles to the south-east, in rugged bush-land rises a large mound of black trap on the top of which are some quaint rough carvings and Pali letters perhaps two thousand years old."

After crossing the B. B. & C. I. Railway line at Borivli station the road goes northward until it reaches *Ghodbundar* which is supposed to be the Hippokura of Ptolemy. There is a good district bungalow situated on the top of a hillock, and reached by a conspicuous flight of stops; it was at one time a Roman Catholic Church but previously, probably a mosque; a Muhammadan Pir's grave is seen quite close to the parapet. A magnificent view of the surrounding district can be had from

the bungalow. To the north lies the Bassein creek with the Tungar Hill beyond; this scenery has been sometimes compared to the Scotch Lakes. The Tungar Hill which is 2,200 feet high and covered with a thick forest, is likely to prove a very desirable site for a Sanatorium on account of its openness to the seabreezes and its comparatively light rainfall. To the west can be seen the long railway bridge over the Bassein Creek, and further west a faint glimpse can be had of the ruined spires of the old Portuguese Churches of Bassein. Near the district bungalow itself are ruins of a large monastery and College. During the days of the Portuguese, *Ghodbundar* with the surrounding district was the property of Martin Alphonso said to be "the richest Don on this side of Goa." The road from *Ghodbundar to Thana* runs along the south side of the creek through a hilly district with pretty scenery and passes by a ruined square building which was the banqueting-house of John de Melos. His mansion stood close by "on a sloping eminence decorated with terraced walks and gardens." As the road approaches Thana, the surrounding country becomes flat and uninteresting. *Thana* was a very important city in the thirteenth century; it was the capital of a great kingdom with an independent Hindu ruler. In 1318 it was conquered by the Muhammadans, and here in 1320 four Roman Catholic priests suffered death for their religion at the hands of the new rulers. The names of these martyrs were: Thomas of Tolentino, James of Padua, Peter of Siena and Demetrius, a lay brother. In 1534 Thana was finally made over by the Muhammadans to the Portuguese, under whose rule it again became prosperous; its Roman Catholic Cathedral belongs to that period. In 1737 Thana was taken by the Marathas and with the fall of Bassein in 1739 the whole of Salsette became their property. In 1774 Thana was stormed by the English and "almost all the garrison were put to the sword," and with the treaty of Salbai in 1782 it finally passed into their hands. In 1816 the Peshwa's Minister Trimbakji Denglia was imprisoned in the fort of Thana, but effected his escape although he was guarded by a strong body of European troops. The story of his escape is as follows:—A Maratha horsekeeper in the service of one of the English officers of the garrison managed to convey to the prisoner the information that friends with a horse were waiting outside. He did this by

singing the information to his master's horse while exercising the animal under the window of Trimbakji's cell. The language of the song was unknown to the English who therefore did not notice the ruse. Bishop Heber who had seen Trimbakji before, was much interested in his escape, and has translated the groom's song into English verse as follows:—

" Behind the bush the bowmen hide,
The horse beneath the tree;
Where shall I find a knight will ride,
The jungle paths with me ?
There are five-and-fifty coursers there,
And four-and-fifty men;
When the fifth-fifty shall mount his steed,
The Deckan thrives again. "

The fort is now used as a jail. In 1825 Bishop Heber himself consecrated the little English Church at Thana. There is a good Travellers' Bungalow and the return journey to Bombay may be made *via* Bhandup and Kurla.

Bassein. — Bassein lies about 28 miles north of Bombay and was in the time of the Portuguese a very important and rich city and although it is now in ruins an idea of its past greatness can be obtained even in these days from the ruined churches, monasteries and other buildings which are well worth a visit. It can be reached by B. B. & C. I. Railway and lies about 5 miles to the south-west of Bassein Road Station.

Bassein appears to have attracted the notice of the Portuguese from very early days and was ceded to them by Bahadurshah, King of Gujarat, in 1534. The Portuguese promptly fortified the place, established themselves firmly there and raised it to such prosperity that it came to be known as the Portuguese Court of the North. Wealthy noblemen adorned the city with a cathedral, five convents, thirteen churches and an asylum for orphans. Only the Hidalgos or Aristocracy were allowed to dwell within the city-walls in " stately buildings two storeys high and graced with covered balconies and large windows. " For over two centuries the Portuguese remained masters of Bassein but in 1739 Chimnaji Appa, a celebrated Maratha General, appeared before the city with a powerful army and after a siege of three

months forced the garrison to capitulate. Bassein thus passed into the hands of the Marathas. In 1780 it was captured by the British, but was restored to the Marathas by the treaty of Salbai. In 1818, however, with the overthrow of the last of the Peshwas it was resumed by the British and incorporated with Thana District.

The old ramparts still remain in a fair state of preservation but the buildings within the walls are in ruins; yet the cathedral and the various churches can still be made out. The following is a short account of the ruins of Bassein.

Beginning from the sea-side the first object of interest is the massive double sea gateway with its well preserved teak and iron doors, one of which bears, partly hidden by an iron bar, the date "20th November 1720." Within the gate on the left is a small temple of Hanuman. On the same side is seen a building with a massive high tower and walls overgrown with trees: this is the Cathedral or Matriz of St. Joseph. The door bears the following inscription in Portuguese cut in stone; "In the year 1601 when the most illustrious Sgr. Dom Frei Aleixode Menezes was Archbishop Primate and the Revd. Pedro Galvao Pereira was Vicar, this Cathedral was rebuilt." The towered front and the side walls with arched doorways and lancet windows are in fair repair, but the roof is gone and the steps up the tower are decayed. On a black oblong tombstone in the chancel to the right of the main altar is the following inscription; "To this grave are transferred the bones of Pedro Galvao, a servant in the Lord, who managed and enlarged this church. He died at Goa on 19th March 1618." At the west end of the nave a half-buried tomb bears the name, "Antonio de Almeida de Sampaioe." The cathedral seems to stand on the side of the church of St. Joseph which was built in 1546. A plain arched passage between the cathedral and a private house to the right is perhaps a relic of the dislike the wives of the noblemen of old Bassein had, to be stared at on their way to church. The open space at the end of the street to the left of the sea-gate is a great square or market; and around it are the remains of what were once fine buildings. One of chief of these was the State House where in 1675 the Governor convocated "the nobles every morning upon consultation" and where they all stood, a chair

not being allowed even the Governor though gouty. The ruined doorway beyond the market belongs to the Castle or Round Citadel. On either side of the door were two pillars of which only the Corinthian capitals are left. Above are a Maltese cross, a coat of arms, a sphere and the date 1606. Inside the gate the whole space is strewed with ruins. To the left along a path choked with shrubs and fallen stones are the ruins of a bastion with the oldest inscription in Bassein. "The first Captain who built this fortress was Garcia da Sa by command of the Governor Nuno da Cunha in the year 1536." These ruins are said to have been older than the Portuguese and to have been the residences of the Muhammadans to whom the place previously belonged. Further back, heaps of rubbish and one or two doored and windowed walls are all that remain of the palaces of the General of the North and of the Captain of Bassein. A little behind the gate of the Round Citadel and near the end of the street that leads from the sea-gate along the wall are the ruins of a very large building supposed to be the house of the Captain or the Court of Justice, but more probably the Church and Convent of the Augustines. The portico which is approached by a flight of five deep steps is supported by four pillars which divide the entrance into three arches leading into the vestibule. In the back ground are the Portuguese Royal Arms and some worn-out devices. Two inscribed stones have fallen, one from the architrave and the other from the tympanum. The writing on the architrave runs as follows: "This portal was built during the government of the Viceroy Dom Miguel de Noronha, Count of Liuhares and on it St. Francis Xavier was placed as patron of the city 10-5-1631." The inscription on the tympanum runs thus: "When Gaspar de Mello de Miranda was Captain of the city and Goncalo and a few other officers were aldermen, this portal, which took St. Xavier as its patron was built in the year 1631". Next to the palace are the ruins of the Factory, the residence of the Factor who was second in rank to the Captain; close by are the ruins of a very large building apparently a granary. Separated from the palace of the General of the North by the large oblong space of the old palace garden are the Church and Hospital of Pity. The Hospital which faces the wall on the river side is a long massive pile with large square courtyard surrounded by a beautiful cloistered arcade. It was

a very old institution and was endowed by the Portuguese Government. The Church though small had a handsome front of finely dressed stone and delicately wrought pillars. Above the doors is a stone escutcheon with a beautiful Maltese cross in the centre and on either side a dragon with a roll in its mouth. Inside the church are two tombstones, the larger one with the inscription: The grave of P. Cabral de Navais and of his son P. Hieromino P. Cabral and his heirs"; the other stone has only a few letters. Not far from the entrance of this church is a modern Hindu temple of Mahadeo, and parallel to it is the Church of Nossa Senhora da Vida which is one of the oldest churches in Bassein. In a grave opened when digging the foundations of a Sugar Refinery were found the bones of a man and horse evidently buried together. A little beyond, in the front of the square, are the ruins of the Church and Monastery of the Jesuits. The Church front, with its Corinthian capitals, the monogram I. H. S. and a cross sculptured on the lintel above the pillars, is acknowledged to be the handsomest piece of architecture in Bassein. Attached to the Church are the ruins of a College, which although overgrown with creepers and trees, are still firm and in good condition; the date over the door is 1636. The foundations of this church and monastery were laid in 1448 by M. Malchior Gonsalves, a close friend of St. Francis Xavier. In the nave of the church near the chancel are two grave-stones, one with the following inscription: "The grave of Isabel de Aguiar, a widow lady, the noble helper of this College. Died on the 24th January 1591". The other inscription runs thus: "The grave of Dona Filipa da Fonseca, a widow lady, the noble helper of this church, to which she gave during her lifetime all she possessed. She died on the 20th July 1628." A little beyond the ruins of the Jesuit buildings is the Franciscan Church of the Invocation of Santo Antonio, the oldest and one of the largest religious buildings in Bassein. The arched ceiling of the chief chapel with elaborate mouldings is fairly preserved. Unlike most Bassein buildings the Franciscan church is of dressed stone and has basalt in its staircases, arches, windows and door-posts; one staircase is still in good condition. There was a Monastery as well as a Church, and the ruins of both can still be traced. Among the tombstones in the nave and chancel one sees the following inscription: "The tomb of His Majesty's

Councillor who died on 24th August 1558 and his wife Donna Luiza da Silva and his heirs". To the right of these Franciscan ruins, and almost between them and those of the church and monastery of the Jesuits, are the ruins of the Dominican Church and Monastery built in 1583. The walls and tower of this church and a little of the peaked roof near the chancel are still standing in good order. On the Gospel side of the altar is the ruined tomb of the patron with a scarcely legible epitaph. The road between the Dominican and Franciscan ruins and the fort-walls leads to the Bastion of San Sebastian with a blocked postern. The inscription stone lies neglected near the land gateway and has the following words: "King Dom Joam of Portugal, the third of his name and when D. Afonso de Noronha, son of the Marquis of Villa Real was Viceroy, and Francisco de Sa, Captain of the Fort and City of Bassai, this bastion named San Sebastian was built on 22nd February 1554". A few yards from the bastion is a modern English tomb with the following words; "Here lies the body of Jane Durham, wife of Andrew Durham, Surgeon, who departed this life in 1776". On the other side of the wall leading from the postern are the ruins of the pier. Inside the wall a passage is said to run to the river, but as the air is bad and puts out lights, this passage has never been explored. On both sides of an old street, nearly parallel to the new high road which runs along the middle of the fort to the sea-gate are the remains of the old stately dwellings of the Hidalgos "graced with covered balconies and large latticed or oyster-shell windows". Near these old mansions in a square overlooking the road are the ruins of the Augustine Chapel of Nossa Senhora de Annunciada. The front is double-arched, the walls and side windows of the chancel are well preserved and parts of a vaulted roof with painted mouldings are still visible.

Alibag, north latitude 18° 39″ and east longitude 72° 57″ is the head-quarters of the Kolaba district. The town lies on the coast, nineteen miles south of Bombay, at the mouth of a tidal creek, locally known as Sakhar creek. The view of Alibag, as it is approached from the sea, is exceedingly picturesque. In the fore-ground is the sea-fort of Kolaba, with its temples, ruined palaces and trees, beyond is the long line of palms broken only by groups of still higher casuarinas. The town itself is almost

hidden. About two miles out at sea, to the south-west of the Koloba fort, a round tower about sixty feet high, marks the Cheul Kadu, a dangerous reef covered at high water on which many a ship has been wrecked.

The section of the Bombay Observatory consisting of sets of instruments for magnetic records, both for automatic registration as well as for direct observation, is housed in a group of specially constructed buildings at Alibag. The officer, who is in charge of the Meteorological and Seismological Observatory at Colaba, is also in charge of the magnetic section at Alibag.

Ambernath is a small village about four miles south-east of Kalyan. It gets its name from a shrine of the god Ambarnath or Ambareshwar, about a thousand yards east of the village over which about the middle of the eleventh century a very rich temple was built. The temple is situated on the left bank of a tributary of the Valdhan river and is built in the many-cornered Chalukya or Hemadpanti style. Considerable artistic work is to be seen inside the temple as well as outside.

Recently the place is becoming famous as the future industrial area for the city of Bombay. The Dharamsi Morarji Chemical Works and the Wimco Match Factory are situated here.

Jogeshwari or Amboli Caves, in Salsette, about two and a half miles south-east of Goregaon, to the north of Bombay, is a very large, once richly ornamented, now decayed Brahmanic temple of the eighth century. It is cut in a low dome of crumbling volcanic breccia in the waving palm-covered uplands that rise between the outer belt of rice-fields and the central Vehar hills. In point of rich carving and a variety of figures and architecture, next to the Kailasa at Elura this is the largest known cave in India. Its length from east to west is 240 feet, or including the two rock-cut passages 320 feet ; and its breadth including the long passage in the south, is 200 feet. According to Dr. Burgess it has the special architectural interest of showing almost no trace of the arrangements of a Buddhist monastery. Its large porticos and courts point to the development of the style that appears in the built temples of Ambarnath near Kalyan (1060) of Pattan Somnath in south Kathiawar (1198), and of the Abu

emples in north Gujarat (1197–1247). It may be roughly stated that if the Dumar cave at Elura were cut in the first quarter of the eighth century, the great Elephanta cave very soon after, then this Jogeshwari cave should date from the latter half of the eighth century.

The Ismail college founded on the donation from Sir Mahammad Yusuf is to the east of the Jogeswari railway station and situated as it is on a hill top commands an excellent situation.

Khopoli, formerly known as Campoli is a small village on the Poona–Panvel high road five miles south–east of Khalapur. Khopoli is at the foot of the Bhor Ghat incline, about 1,600 feet below Khandala on the crest of the Sahyadris. The place can be reached by a special branch Railway line from Karjat, which is a station half–way between Bombay and Poona. The first of the Tata hydro–electric installations is at Khopoli.

FOREWORD

The 21st. session of the Indian Science Congress was to be held in Poona. This guide book was therefore compiled for issue as a souvenir of the occasion. However, owing to the unfortunate prevalence of plague in Poona, the venue of Congress had to be shifted to Bombay, almost at the last moment. With the concurrence of the Bombay organisation, it was decided to issue a joint hand-book "Bombay–Poona"; and the pages that follow comprise the Poona portion. Thanks are due to the large number of individuals and institutions who extended their co-operation by supplying information and articles for the hand-book. The major portion of editorial responsibility was readily undertaken and enthusiastically carried out by Professor M. R. Paranjpe to whom the Poona organisation of the Science Congress is deeply grateful.

POONA

CONTENTS

Bombay to Poona.

Electrification of the Railway Line.

As the crow flies Poona is about 60 miles from Bombay but the distance by rail is 119 miles. When the train leaves Victoria Terminus the train first goes north east for about 35 miles; then it sharply turns southeast and keeps on in that direction till it reaches Poona. Formerly the journey took about six hours, which was later reduced to $4\frac{1}{2}$ and now the fastest trains of the G. I. P. R. cover the distance in three hours. It is now possible to leave Poona early morning at about 7–30, reach Bombay at 10–30 or 11, do one's work there and return to Poona by 8 P. M. Similar facilities are available for a person wishing to go to Poona and return on the same day. This would have considerably increased passenger traffic between Poona and Bombay, but a part of it is absorbed by the motor buses which run between the two places and compete with the Railway Company in this respect.

The most attractive feature of this journey is the sight of the Bhor Ghat and the many tunnels on the way. " The Bhor incline begins at Karjat station near the village of Palasdari sixty two miles from Bombay and 206 ft. above the sea level. As the crest of the ascent is about 2327 feet, the height of the incline is 1831 feet and the distance 15 miles or an average gradient of one in forty-six. On leaving Palasdari or Karjat the line passes on its course through six tunnels of 66, 132, 121, 29, 136 and 143 yards. Then bending north it climbs to the station, Thakurwadi, a distance of 6 miles. In the last two miles there are eight tunnels of 286, 291, 282, 49,140, 50, 437 and 105 yards. Further on appear nine tunnels of 81, 198, 55,63, 126, 79, 71, 280 and 121 yards. With three more the total number of tunnels is 26 and the total length is 3986 yards or more than $2\frac{1}{4}$ miles. That was when the tunnels were first cut. Three more tunnels have since been added to eliminate the Reversing Station. Their aggregate length is 4,598 feet or 0'87 of a mile.

To one travelling along the line, particularly in the rainy season, the Ghats are a great attraction and the traveller welcomes the retardation in speed which is inevitable when the train leaves Karjat and begins the steady ascent of about 1800 ft. above the sea-level. The steep hills with rock-cut forts at their tops, the deep valleys, the many water-falls and meandering streams of water, the green fields and the rich flora captivate the eye of the young and the old, the ignorant and the learned. But the impatient business-man who travels daily between Poona and Bombay and owing to familiarity is blind to this wealth of nature, curses this obstacle which delays the run by about an hour. To him the electrification of the line, the conquest of Nature by Science, is a great thing. On the 5th of November 1929 His Excellency Sir Frederick Sykes, the then Governor of Bombay, performed the inauguration of the newly electrified main line section of the G. I. P. Railway. The following account taken from a booklet published on this occasion by the Railway Company will be read with interest.

" Communication between Bombay and Poona, the monsoon capital of the Presidency, has always been a matter of first class importance and as far back as 1830 when the first road way up the Bhor-Ghat was constructed it was claimed that " by rendering the transit of merchandise on wheeled carriages available and thereby facilitating intercourse between the Deccan and the Conkan, permanent and solid advantages to the country are secured ". Shortly afterwards the mails from Poona which had previously been taken by boat across Bombay harbour, and thence by coolie, were sent by regular mail cart service along the road. Passengers were conveyed by this service, the journey then occupying 24 hours and costing about Rs. 100.

" The G. I. P. Railway Company was incorporated in 1849 and its first line to Thana was completed in 1853. The great task of carrying the track over the formidable Ghat barrier was then undertaken and 10 years later through rail communication with Poona was established. The construction of the Ghat section was undoubtedly a fine engineering achievement, not the least ingenious feature being the Reversing Station necessitated on account of the broken country and the heavy

gradients encountered. This has now become obsolete and the route has been realigned so that trains can be taken right through the section without any halt.

" George Stevenson who built *Locomotive No. 1* in 1825 predicted in 1847 that electricity would become the great motive power of the world. The opening of the mail line electric service is another step in the fulfilment of his prediction. Among the advantages to be obtained from electrification, the most important are:

1. Freedom from smoke in the towns and the tunnels through which it passes.
2. Improvement of passenger train services both as regards schedule speed and frequency of trains.
3. Increase in carrying capacity of the line without costly additions to permanent way, owing to the haulage of heavier trains at higher speeds.
4. Reduced cost of haulage compared with steam traction and reduction in wear and tear to rolling stock owing to the employment of regenerative braking.
5. Reduced risk of locomotive failure and loss of time on locomotive account.
6. Economy in coal consumption and the utilisation of lower grades of coal in the power house.
7. Freedom from anxiety about failure of water-supply.

" The principal features of the Main line electrification are as follows:

The Power House at Kalyan:—The coal which can be of a lower grade than that used on steam locomotives is unloaded into a filler pit in which it is crushed. From the filler pit the coal is taken by an endless rubber belt to a junction tower from which its can either be run out to the stacking area or diverted to the coal bunkers above the boiler house. The bunkers are parabolic in section and have a total capacity of 1000 tons. The coal is fed to the fire boxes through shoots which provide even feed to the grates below.

" *Boilers*:—There are six boilers fitted with suspended liptak arches, forced and induced draught fans, superheaters

nd economisers. The economical continuous output of each boiler is 60,000 lbs. of steam per hour when fired by coal alone and when oil fuel is used to supplement coal firing a maximum output of 105,000 lbs. of steam per hour can be obtained. This enables the boiler to deliver the additional steam required at "peak load" periods.

" *Turbines*:—Steam at a pressure of 250 lbs. per square inch and a temperature of 700° F. is supplied to the four turbines which are of the reaction type and which run at a normal speed of 3000 revolutions per minute. The generators develop 10,000 kilowatts each as three phase currents at a normal pressure of 6600 to 6750 volts between phases and at a frequency of 50 complete cycles per second.

" *Condensers*:—From the turbines the steam passes to the surface condensers at a pressure of 1 lb. per absolute square inch. The cooling surface of each condenser is 14,500 square feet and with 24,400 gallons of cooling water per minute a condensate temperature of 96°F can be obtained.

" *Pump House and circulating water System*:—In the pump house there are five screen chambers (of which there are three at present filled with screens) and three pump chambers containing three large and two small pumps with accommodation for one additional large pump. The condensing water is taken from the Ulhas river and after passing through motor driven inclined rotary screens is pumped up to the condensers in the engine room basement through a length of about 1200 feet of 42 inch diameter cast iron piping, the discharge being made through two 42 inch diameter pipes to an outlet of about 2000 feet down stream from the pump house. The capacity of the pumps which are of the vertical centrifugal type, is 64000 gallons per minute i. e. about 4000,000 gallons per hour. The combined brake horse power of the corresponding motors amounts to 1,269.

" *Electric Generating System*:—The current from the generators is taken via the 6600 volt switch gear (which is of the ironclad draw-out type) to the transformer banks in the outdoor sub-station. Each transformer bank is of 11,000 K. V. A. capacity and 'steps up' the pressure to 95,000 volts which is the voltage of the extra high tension transmission line. The extra

high tension switching operations are actuated from the control room which is in a building separate from but adjacent to the power house.

" *Transmission line*:—Two double extra high tension transmission lines run from the power house to Kalyan and from that point two lines are run to Kirkee (Southeast Section) and two to Igatpuri (Northeast Section). The total length of the transmission lines is approximately 270 miles. The towers are of the lattice type the steelwork being galvanised. The normal span is 700 feet. There are about 2000 towers and the height of each is about 70 feet. The conductors are of stranded aluminium cable with a steel core and a total length of 840 miles of this has been used. The total weight of steel works used in these towers is 5,000 tons. From Khopoli to Lonavla the high tension line is run in triplicate, the actual ascent of the ghat being made on either side of the Tata Hydro-Electric pipe line.

" Owing to its situation half way up the ghats the Thakurwadi sub-station is supplied with power from Karjat at high pressure of 22,000 volts partly through a 3-phase transmission line carried on the track structures and partly through cables running along side the track.

" *Sub-Stations* :—The extra high tension transmission lines are teed into sub-stations situated about 12 miles apart so that the pressure can be 'stepped down' and the electrical energy be fed into the overhead track conductors at suitable intervals as direct current at 1500 volts.

" There are 7 sub-stations on the main line system these being situated at Vangani, Karjat, Thakurwadi, Lonavla, Kamshet, Shelarwadi, and Kirkee (on the Poona line). The substations at Vangani and Kirkee are 3-unit sub-stations the remainder being 2-unit sub-stations. The voltage is transformed from 95,000 to 560 and the electrical energy is then converted into direct current at 1500 volts by means of rotary converters arranged in pairs and running in series. Each rotary converter set has a capacity of 2500 kilowatts on a continuous rating and can take heavy overloads for short periods.

" The direct current switch gear is of the draw out truck type and the high speed circuit breakers are mounted on the

draw out portion of the trucks. The direct current from the sub-stations is carried by cable to the overhead track structures and is fed to the conductor through lightning arrester cabins at a pressure of 1500 volts. The return current passes through the track rails which are bounded at the joints.

" *Track Equipment*:—The overhead track equipment is carried on steel structures which are either of the broad flange beam type or the fabricated type. The over head equipment consists of a main copper catenary, an auxiliary copper catenary and a copper contact wire, the total sectional area of this system being 1 sq. inch. About 8500 tons of steel-work were required for supporting the equipment and about 3000 tons of copper were required in the form of conductors alone.

" *Locomotives*: The electric locomotives which will be used for the service on the electrified portion of the Main line have been described as being " amongst the largest and most interesting as yet built in England."

" *Freight Locomotives*: The design of the freight locomotives was decided on the consideration that trains should be hauled by two locomotives on the Ghats and by one only elsewhere and that the maximum through loads should be 1000 tons from Bombay and 1600 tons towards Bombay. A tractive effort of 50,000 lbs. was therefore specified. The locomotives are capable, however, of producing a much greater tractive effort on occasions (upto 82,500 lbs). Each locomotive weighs just over 120 tons the whole of which weight is available for adhesion. They have two trucks, each with three coupled axles. There are two motors to each truck, power being transmitted to the driving wheels through an intermediate jack shaft and connecting rods. The length of the locomotives over buffers is approximately 66 feet, rigid wheel base 15 feet 1 inch and wheel diameter 48 inches.

" The control equipment is located in a high tension compartment in the middle of the locomotive and is so arranged that when a train is descending a heavy gradient, the motors, instead of driving the locomotive, are driven as generators and return (to the line) energy which becomes available for other

trains working on the system. A retarding effort of 45,000 lbs. can be obtained in this manner.

This arrangement also has the advantage of reducing the heavy wear which takes place on tyres and brake blocks when trains are descending the ghats in the ordinary way.

" *Passenger Locomotives*: In order to ascertain the best type of passenger locomotive for use under Indian conditions, three different types were ordered for trial purposes. Each of these locomotives has three driving axles but the method of drive and suspension is different in each case.

" Each driving axle is driven by two motors of 360 horse power each. The control is electro-pneumatic as in the case of the freight locomotive; no regenerative braking is however, provided as freight locomotives will be used in conjunction with these locomotives on passanger trains ascending or descending ghats.

" A draw bar pull corresponding to 1000 horse power at 70 miles an hour can be exerted by these locomotives and smooth running has been obtained at speeds up to 80 miles an hour. The length over the buffers is 52 ft. 6. in. rigid wheel base 7 ft. 6 in. diameter of driving wheels 63 inches and diameter of carrying wheels 43 inches. "

The total amount of the original estimate exclusive of the Power House was approximately £ 4, 150.000 i. e. about 5·53 crores of rupees; that of the Power House at Kalyan was Rs. 97, 40, 420.

Poona

POONA DISTRICT.

Physical Features, Location etc.:—Lying between 17° 54 and 19° 22′ north latitude and 70° 24′ and 75° 14′ east longitude the District of Poona has an area of about 5320 square miles and a population of 1,169,798 or 219 to a square mile. In 1881 these figures were 900,621 and 168 respectively.

In the west along the Sahyadris, Poona district has a breadth of seventy or eighty miles. From this it stretches about 130 miles southeast, sloping gradually from about 2000 to 1000 feet above the sea and narrowing in an irregular wedge-shape to about 20 miles in the east. On the north and on the east it is bounded by parts of the Ahmednagar District. Sholapur surrounds its south-east corner. On the south it is bounded by parts of Satara and on the west touches Kolaba and Thana.

In the gradual change from the rough hilly west to the bare open east, the 130 miles of the Poona District form in the west two more or less hilly belts ten to twenty miles broad and 70 miles long. Beyond the second belt whose eastern limit is roughly marked by a line passing through Poona north to Pabal and south to Purandar, the plain narrows to fifty and then to about 20 miles and stretches east for about 90 miles.

The hills of the district belong to two distinct systems. One running on the whole, north and south, forms the main range of the Sahyadris, about 73 miles in a straight line and about ninety following the course of the hills. The other system of hills includes the narrow broken-crested ridges and the bluff-topped masses that stretch eastwards and gradually sink into the plain. The crest of the Sahyadris falls in places to about 2000 feet, the level of the western limit of the Deccan plateau. In other places it rises in rounded bluff or clear-cut ridges 3000 or 4000 feet high.

The District of Poona is crossed by many rivers and streams which take their rise in or near the Sahyadris and flow east and south across the district. The chief river is the Bhima which

crosses part of the district and for more than a hundred miles forms its eastern boundary. The Mula and Mutha on the confluence of which the city of Poona is situated, are tributaries of the Bhima. The famous temple of Bhimashankar on the crest of the Sahyadris, twenty miles north of Khandala, marks the source of the Bhima. Bhimashankar is one of the twelve great *lingas* of India.

History—From very early times trade routes must have crossed Poona district down the Sahyadri passes to the Konkan sea ports of Sopara, Kalyan and Chaul. Rock cut temples, rest chambers (Viharas) and inscriptions show that as far back as the first centuries before and after Christ trade went to and from the coast by the Nana and Bhor passes. The richness of the rock-cut temples both above the pass at Bedsa, Bhaja and Karla, and below the pass at Kondane and Ambivate makes it probable that in the first centuries after Christ a great traffic moved along the Bhor pass route. The early history of the district centres in Junnar, on the Nana pass route, fifty miles north of Poona, a city strongly placed in a rich country with good climate and facilities for trade. Of the founders of Junnar nothing is known. Even its early name has perished if, as is generally supposed, the present name Junnar means 'old city' (जीर्ण नगर). The town is probably as old as the large inscription on the walls of the rock-cut chamber at the head of the Nana pass which was engraved by a Deccan King, one of whose capitals was probably at Junnar and whose date probably lies between B. C. 90 and A. D. 30.

For 900 years ending early in the fourteenth century with the Mussalman overthrow of the Devagiri Yadavas, no historical information regarding Poona is available. Not a single stone or copper plate has been found in the Poona District belonging to the three great dynasties of Chālukyas (550 to 760), Rāshtrakutas (760 to 973) and Devagiri Yādavas (1190 to 1295). Still, as inscribed stones and copper plates have been found in the neighbouring districts of Ahmednagar, Sholapur and Satara, it is probable that the early and eastern Chālukyas held the Poona District from 550 to 760; the Rashtrakutas to 973; the Western Chalukyas to 1184; and the Devagiri Yadavas till the Mussalman conquest of the Deccan, about 1300.

From 1318 Maharashtra began to be ruled by the Governors appointed by Delhi and stationed at Devagiri. In 1346 there was a wide-spread disorder and the Delhi officers plundered and laid waste the country. These cruelties led to the revolt of the Deccan nobles under the able leadership of an Afghan soldier of fortune, name Hassan Gangu. The nobles were successful, and freed the Deccan from dependence under northern India. Hassan founded a dynasty which, in honour of his patron a Brahman, he called Bahamani and which held command of the Deccan for nearly 150 years.

In 1515, King Bahadur Nizam II ennobled a Maratha, named Maloji Bhonsala, with the title of Raja and enriched him with the estates or *Jāgirs* of Poona and Supa and the charge of the forts and districts of Shivaner and Chakan. Maloji was the grand-father of Shivaji who was born in Shivaner fort near Junnar in May 1627. (According to some in February 1630). The district of Poona and the City are thus intimately associated with the birth and childhood of the founder of the Maratha Empire.

* * *

Students of Maratha history who move about the district and in the City of Poona will find every inch of ground reminding them of the deeds of Shivaji and his followers. Shivaneri, the birth place of Shivaji is about 70 miles to the north of the town. The State of Bhor, to the south of Poona supplied Shivaji with his army of Mavlas, of whom Tanaji Malusare, Yesaji Kank, and Baji Pasalkar were his bosom friends when he was a boy and his trusted commanders when he began his conquests. The fort of Sinhagad which was stormed by Tanaji in 1670 and where he, died in the attempt, is at a distance of 18 miles from Poona. The fort of Purandar which is still preserved in good condition, and where Shivaji signed the treaty with Jayasing is almost at the same distance but in the south-east. Pratapgad, the fortress where Shivaji met Afzulkhan and had his first trial of strength with the mighty power of Bijapur is not much removed but lies in the district of Satara. Jejuri, where is situated the temple of Khandoba, the family deity of many a Maratha noble is

half way between Poona and Baramati. The surprise attack on Shahistekhan from which he escaped with the loss of two fingers occurred in the city of Poona. Raigad which later became the Capital of Shivaji, Torna which was his first conquest, Lohagad, Rajmachi, and other well-known fortresses are all in or about the Poona District.

The district also boasts of certain places hallowed by the residence of saint-poets. Alandi about fourteen miles to the north of the city, was the last residence of Dnyandev who interpreted Bhagavatgita in Marathi in his famous book, Dnyaneshwari; it is a great pilgrim centre. Dehu not far removed from Shelarwadi station was the residence of Tukaram, another well-known saint-poet of Maharashtra. Baramati about 70 miles to the south-east was the residence of Moropant who flourished in the last dacade of the 18th century and is a well-known Marathi poet.

After the death of Shivaji and during the long-drawn war of independence from 1690 to 1707 the city of Poona was almost forgotten, but it rose again in importance when Peshwa Bajirao I chose it for his residence, and during the next hundred years it became the centre of Maratha politics. The reputation was later maintained by the rise of the two great political leaders of all-India reputation, Bal Gangadhar Tilak and Gopal Krishna Gokhale.

Geology—Almost all the rocks around Poona are varieties of Deccan Trap. The prevailing rocks are basalts containing plagioclase, augite and iron ores. The colour and texture of the rocks vary greatly but the original minerals of the rocks can rarely be identified in hand specimens. Few rocks are compact; generally they are vesicular, the vesicles being partly or entirely filled with secondary minerals like crystalline and amorphous quartz, zeolites, glauconite, calcite etc.

The traps have resulted by cooling and consolidation of extensive lava sheets poured out intermittently through huge volcanic fissures. They are found in horizontal beds and on weathering give rise to gently undulating plains covered with numerous hill ranges having flat tops and conspicuously step-like sides. The eruptions took place towards the close of the Cretaceous period when vast areas in the Indian Peninsula

were covered by lavas ; the area covered by these rocks to-day is not less than 200,000 sq. miles.

On weathering the rocks form ball-like masses with concentric layers like the coats of an onion. A rude prismatic jointing is often present but symmetrical prismatic columns are rarely seen.

Beds of volcanic ash are common in the district ; these and several thin bands of red or green earth are distributed here and there between basalt-beds.

Almost everywhere the traps yield good building stone and road material. Some compact dark varieties are capable of taking a high polish and are used for idols and ornamental purposes. Irregular nodules of calcium carbonate, *Kankar* which are useful in preparing lime, occur in several places especially in the eastern parts of the district. In a few places the soil contains small quantities of natural salts, common salt, soda, or a mixture of the two.

THE CITY OF POONA.

Poona is pleasantly situated at a height of about 1850 ft. above sea level at the confluence of the Mula and the Mutha, two of the innumerable rivulets that originate in the Western Ghats, numerous spurs from which almost enter the city, both from the west and the south. Towards the north also the country is somewhat undulating, but to the east it opens out into fertile plains through which the combined waters of the two streams flow.

On the west lies a flat-topped range of hills with only one crest called the Vetal. It has three off-shoots viz. (1) the Chatushringi Hill, (2) the Fergusson College Hill and (3) the Hanuman Tekadi. On the south lies a broken series of hillocks of which the Parvati, with the famous temple of that name is the most prominent. Between these two ranges lies the beautiful valley of the Mutha as far as the eyes can reach in the southwest direction. The Mula enters the city from the northwest side. In the north-east corner there stands an isolated rock, with the palatial mansion, 'Parnakuti,' of the Thackerseys just above the Bund, a dam over which the river flows. All these hills and hillocks

command a pleasing and variegated view of the city with its fine orchards, gardens, trees, numerous old and modern buildings such as the Government House, Temples, Churches, Hospitals, Hotels, Markets, Mansions, Palaces, Schools and a series of Colleges that almost surround it.

The oldest part of the city, called the Kasaba Peth between the old stone culvert or the Dagadi Pool and the new Lloyd Bridge, has outgrown into the present city that spreads on the south side of the Mula-Mutha. The Greater Poona, however, extends both over the space between the two rivulets and on the north side of the Mula-Mutha as far as Kirkee. The entire city with its suburbs, the Camp and all extensions, old and new, comprise an area of nearly twentyfive square miles; its length from the foot of the Vetal Hill in the west to the far end of Ghorpadi in the east and the breadth from the foot of the Parvati in the south to the far end of Kirkee in the north, being more than five and half miles and four and half miles respectively.

The city is supplied with water mainly from The Khadakwasla Tank created by building a dam across the rivulet Mutha years ago. It is a good reservoir, the catchment area being more than twenty square miles. Two canals called the right-bank canal and the left-bank canal run almost parallel to the river as far as the City of Poona and go beyond it, one along its southern side and the other along its western side. At the time of the Peshwas, however, and even as late as the last decade, the city got its water from the Katraj tank in the hill range of the same name, six miles away, to the south.

Another special feature of the city is that it has a junction of railways, the G. I. P. Ry. and the M. S. M. Ry., just opposite the Sangam towards its east. From here the M. S. M. Ry. lines travel towards the Southern Mahratta Country and the G. I. P. Rails traverse the country in the southeast direction as far as Raichur and in the northwest direction as far as Khandala, where they descend the Western Ghats and go further down to Bombay.

POONA BEFORE 1818.

Under the Mahomedans in the 16th. century Poona was held as a Jahgir by Shahaji Raje Bhosle the father of Shivaji. Shahaji

assigned 36 villages to Shivaji when he was 12 years old (A. D. 1642). After Shahaji's transfer to the Karnatak, Poona was ably managed by his agent Dadaji Konddeo under whom Shivaji received his education. Shivaji's achievements which resulted in the foundation of the Mahratta Empire commenced when he was in Poona. The quadrilateral of forts on which rested the main strength of Shivaji lies in the neighbourhood of Poona, the four forts being Sinhagad, Purandar, Rajgad and Torna. Shivaji's palace, Lal Mahal lay opposite to the site of the Shanwar Wada of the Peshwas. Poona appears then to have been a fortified town, but the fortifications were dismantled by Morar Jagdeo a minister of Bijapur. At some distance from the confluence of the Mula and the Mutha, once existed two great temples of Puneshwar and Narayaneshwar. As .early as the 13th century two Mohammadan saints stayed in these temples which were soon converted into mosques as can be easily discovered even by a casual visitor.

But the real importance of Poona commenced from the time when Peshwa Bajirao I, chose it as a suitable place for being made the capital of the Mahratta Empire (A. D. 1735). Thenceforward Poona fast developed into a big city which was destined to occupy the proud position as the chief centre of political activities in the whole of India during the latter half of the 18th century.

Poona is said to have been formed out of a few villages round about, and in the days of Shahaji and Shivaji it consisted only of that part now comprising the Kasaba Peth, while beyond the walls all was jungle. Bajirao's son Nanasaheb decided to raise a palace for the Peshwas just beyond these walls and selected the present site because here, so goes the legend, a hare successfully chased a dog. The chief door or the palace points exactly towards Delhi and this most faithfully represented the true objective of the Maratha warriors and statesmen of the time. Inside the walls was built a mangificent palace Shanwar Wada of which we get some idea from the plinth still standing. The palace was a six storeyed building with several Mahals like the Ganpati Mahal and the Mastani Mahal. Additional buildings were also raised from time to time. The palace was well served by wells and cisterns, supplied with water specially brought

through a strong brick conduit from the Katraj Tank a few miles away in the hills. One of the fountains, the one in which the Peshwa Savai Madhavrao threw himself in a fit of fever, was so designed, it is said, as to give a fine display of rainbow colours in artificial light. The famous *chadar* device was also used there. The wide walls defending the palace could accommodate inside hundreds of guards in the eight bastious and other rooms in the walls. The palace was a splendid specimen of its type in the Deccan, though it faded into insignificance by the side of similar buildings in north India and in the extreme south of the Indian peninsula.*

Under Savai Madhavrao Peshwa an extensive menagerie (Shikarkhana) was maintained by the Peshwa in a 'Ramna' or a park at the foot of the Parvati Hills. There was a good collection of quadrupeds, birds and fish, numbering perhaps a hundred varieties, and the collection was unique in the Deccan. Major Price and Sir Charles Malet who had visited this Shikarkhana described it with great appreciation in 1792. Some of these animals were trained for purposes of sport. Sir Charles Malet got prepared clay models by a Brahmin artist, of all these animals; paintings of these still exist in the Satara Museum.

Round about Poona there were gardens such as the Hira Bag, Saras Bag, Bag Parvati, Bag Wanavadi, Bag Hingne, Bag Ramna, Bag Wadgaon, Bag Manik, Bag Pashan, Bag Katraj, etc. The Hira Bag contained the treasure house built by Balaji Bajirao about 1780. Two British noblemen were entertained in

* Shanwar Wada was founded on 10th January 1730. Opening of the Palace (two-storeyed palace with three quadrangles quadrangles) on 22nd January 1732. Expenditure-Rs 16,110/-.

Balaji Bajirao made many alterations and additions and Nana Phadanavis gave the final touch by adding galleries, towers etc. and made the palace truly majestic. The Palace was destroyed by fire in 1827.

The Delhi Darwaja was almost an exact replica of the gate of Indraprastha of the Purana Killa of Delhi. A skilful artist from Jaipur named Bhojraj was entrusted with the work of decorative painting in the Peshwas' Palace. The number of attendants in 1779 were recorded to be 3, 144 men in addtion to, some 300 to 500 Sowars in attendance day and night. The palace had four large courts or Chowks. The names of the Darwajas were- the Delhi Darvaja, the Ganesh Darwaja, the Mastani Darwaja, the Khirki or Kavathi Darwaja and Jambul Darwaja.

this garden in 1873 and the distinguished guests are said to have partaken of a Hindu dinner in oriental fashion. A part of the treasure house may be seen today turned into the town hall.

In 1764 a special Kotwali Department was opened which was located in the Kotwal Chavdi (now in Budhwar Peth) in 1768. The Kotwali arrangements i. e. corresponding to the police, were very efficient. The Kotwal or the Police chief had under him an Amin, a Diwan, a Phadnis, a Daftardar, a Potnis and 78 constables and watchman.

As has been observed by Sir Charles Malet, Poona was not an industrial centre and there were no schemes of commercial expansion. The chief source of income of the state was land revenue. The Mahratta Government had another special source of income viz. that derived from *Chauth* and *Sardeshmukhi*, which they levied on the strength of the Imperial Farmans obtained by them in 1719 from Delhi from territories not directly governed by them and called the Moghalai, as distinct from 'Swarajya,' i. e. the Mahratta territories proper.

In the latter half of the 18th century, 'two gold streams' as the Peshwa Nanasaheb calls them in one of his letters, flew towards Poona, one from the North and the other from the South. But unfortunately they dried up before reaching the capital. Thus Poona hardly rivalled the magnificance of Delhi, Lucknow or Bijapur. But the Peshwa's Palace, together with its fine series of Mahals like the Arse Mahal, the Asmani Mahal and Diwankhanas or halls like the Gokak, the Nach, the Kacheri, the Hastidanti, all in fine Kalamdan style with beauitiful carvings and cypress patterned pillars adorned with paintings in enamel and gold, and its marvellous and unique thousand-jetted fountains, was an object for admiration in those days.

The Parvati Hill to the south of the City was adorned with some beautiful shrines by the Peshwa Balaji Bajirao alias Nanasaheb and became the occasional residence of the Peshwas. The hill with its shrines and palace together with a lovely artificial lake at the bottom of the hill was a charming spot. On the sides of the lake stood beautiful gardens and in the centre was a small island where peacocks and other birds were kept. Here the Peshwa used to rest after some refreshing boating in

the lake, while music would play from adjacent temples. On the other side of the hills were walls, which are still standing, enclosing the huge enclosure where the Peshwas destributed gold and silver to the thousands of Brahmins gathered from all parts of India, during the month of Shravan. The Brahmins used to assemble in this enclosure, and at various doors stood the Peshwa and his agents to distribute Dakshina to them on recommendation of learned Shastris of the Court, who had previously tested the attainments of each recipient. The lake has dried up, the boats have disappeared, the music is no more heard, though the Parvati Hill stands and the temple continues to be administered by Trustees under the award from the High Court of Bombay.

POONA SINCE 1818.

In his life of the late Mr. Bal Gangadhar Tilak, Mr. N. C. Kelkar has inserted a chapter reviewing the history and progress of Maharashtra in the fifty years before the advent of Tilak. The following brief summary of that chapter will, it is hoped, be found instructive. Once Bajirao, II left Poona for Bithur the Peshwas appear to have lost touch with their capital altogethor. Not one of the Bhat family, at any rate no near relatives of the Peshwas, appear to have made Poona their abode. The Shanwar Palace of the Peshwa became the court house, and in the Budhwar Palace was located the public library. Those who went with Bajirao seldom returned to Poona and if they ever did return their arrival or departure went unnoticed. Even the news of the death of Bajirao appeared in an obscure corner of the local paper, Dnyanprakash.

The states of Gwalior and Indore were creations of the Peshwa and occasionally their princes visited Poona but even in their case the ties had become loose. Mahadaji Scindia died at Wanowrie, a suburb of Poona, but not much care was taken of his *samadhi* at the place. The condition of petty chiefs and jagirdars became pitiable. They lost their authority and a good part of income and had to [illegible] the favour of British officials even to retain what was left. [illegible] priests and the learned shastris who formed a very respectable class of people during the regime of the Peshwas steadily lost their hold on the society.

The class however which appears to have retained its position and even prospered a bit consisted of the Brahmins, Prabhus and Shenvis who had clerical jobs. They learned English and helped the new administration in the work of consolidation and during the earlier part of the British regime the Collector's head-clerk often wielded greater power than the Collector himself.

Why did the British Government introduce modern education in these provinces conquered by them ? It is possible some of its advocates were actuated by atruistic motives only, but it is not unlikely that others saw in it an excellent instrument:

(1) To secure trained staffs in their administrative departments.

(2) To anglicise the minds of the people and thus secure a good custom for English wares.

(3) To convert them to Christianity.

And all these objects were certainly achieved in the first few years of the British domination. But the glamour soon disappeared and at the end of half a century of modern educatiou a definite reaction had set in. Even these who receded from the superstitions of the Hindu religion, recoiled with equal rapidity from Christianity. Referring to this question in one of his articles in the quarterly journal of the Sarvajanik Sabha, Poona, writes Mr. M. G. Ranade: "It is a great relief to us to find that as the result of 50 years' study Dadoba (a leading member of the Prarthana Samaj), though he reveres the Holy Bible and has made Christianity the favourite study of his life, has failed to accept the current doctrines of the Christian religion. There is not a single point among the cardinal doctrines of the Christian Churches to which Dadoba has been able to subscribe his unqualified adhesion, nay more, he has expressed his dissent from the philosophy and rationale of these doctrines with unmistakable freedom." But with dogged persistence the Christian Missionaries continued to distribute leaflets, attack silly superstitions in Hinduism and advise people to accept the religion of Jesus Christ, and not infrequently were drawn into discussions with the supporters of the Hindu religion. As in the matter of the spread of Christianity, it is not unlikely that some of the British administrators had clearly

perceived that the spread of education, which apparently had helped to put the new administration on a solid basis, might one day be the instrument to dislocate it.

During the regime of the last three or four Peshwas it was customary to invite learned men from different parts of India and distribute to them money-gifts called Dakshina. Mountstuart Elphinstone who had the sole charge of the administration after 1818, stopped these money-gifts but decided to use the amount for founding and maintaining a Sanskrit Pathashala, in Poona in 1821. This Pathashala may be regarded as the source of all the educational institutions in this city. In 1842 an English Class was attached to it and in 1851 it was raised to the status of a collegiate institution and began to be called the Poona College. In 1863 it was found necessary to remove it outside the city and in 1868 it was finally located in its present buildings on the other side of the Mula-Mutha confluence, and has been since known as the Deccan College. The institution in the city however continued to do its useful work as a high school, known later as the Vishrambag High School, because it was located in the Vishrambag palace (now occupied by the Poona Municipality). To this high school was attached a class for training teachers, and an unsuccessful attempt was made later to develop it into an institution of the status of the Deccan College, but imparting all instruction in Marathi. When the University of Bombay was constituted in 1857 knowledge of English became the chief criterion of learning, Sanskrit became a *second* language and the study of Marathi almost disappeared.

In the Matriculation examination of 1859 appear three names from Poona, Baba Gokhale, Venkatrao Ramchandra and V. B. Sohoni and they were contemporaries of R. G. Bhandarkar, V. A. Modak, M. N. Paramanand, M. G. Ranade, K. Bedarkar and B. M. Wagale all of whom occupied high positions in later life. English education was steadily increasing in popularity and in 1876 the number of students appearing at the Matriculation was a little more than 1100 and the number of B. A. s in that year 16. Mr. Tilak was the 180th B. A. of the Bombay University. Even at this stage complaints were raised about the new education, and the following criticism is found in a number of Dnyanprakash, about this time: "The rapid

advance of English education is making the students weak and unhealthy. They become unqualified to shoulder the burden of college studies and even if they do they grow weaker still ". Of course it was not suggested that the cure lay in discontinuing English education.

In 1871 was established the first women's association called " Vicharavati Stree Sabha " with 8 women members. Commenting on it, writes the Dnyanprakash of 9th Jan. 1871 : " We are pleased at the fact that this City of Poona has an association of women, a thing unknown in any part of the Presidency, perhaps in the whole of India". But, proceeds the paper, " some people believe that founding such associations now is like asking a child to run before it learns to crawl ".

The non-Brahmins in Poona were backward in education and their first leader in this city was the late Mr. Jotirao Fule, a mali by caste. He was apparently much ahead of his time. In 1848 he started a school for the backward classes, taught his wife to read and to write and made her teacher in his school where girls also were admitted. He also conducted for a time a school for the depressed classes, and an orphanage for discarded children. His work was very much appreciated by Government and the Christian Missionaries, as also by the advanced section of the Poona public. In 1874 he established his " Satyashodhak Samaj ", an Association of the Seekers of truth and advocated chiefly the release of the non-Brahmin class from the slavery of the priesthood. In 1877 he started a weekly journal called " Deenabandhu ", Friend of the Oppressed, and thus forestalled Tilak and Agarkar who similarly started " Kesari " and " Sudharak " to propagate their views on political and social matters. Mr. Fule's publications were violently criticised later by Vishnushastri Chiplunkar and perhaps that criticism was deserved by Fule owing to his unbalanced writings; but at this distance of time he deserves an honourable mention among the pioneers who worked for the advancement of the non-Brahmin classes.

"Dnyanprakash" was first published in Poona in February 1849. It was a weekly and had eight pages of 10 × '8'. It was lithographed and its subscription was Rs 10 per year. Fifteen years after that, it used to be printed from types and the subscrip-

tion was reduced. It has passed through many vicissitudes. First purely Marathi, then Anglo-Marathi, weekly, biweekly and daily. At present it is a Marathi daily and is regarded as a prominent organ of the liberal opinion in the city.

In the issue of Dnyanprakash of 18th Sept. 1871 a contributor writes: (" In the last fifty years) Faith has got wings and is flying up in the air. The old 'Angarakha' is fast disappearing yielding its place to coats and trousers. One does not feel one looks graceful without boots and stockings. The turban is now out of fashion and people appear to favour woollen sailor-caps instead. In winter formerly one tied round one's head the *rumal* now they use the comforter; shirts have usurped the place of double breasted jackets. In summer people drank cooled scented water; now the areated water is the fashion. There was but one Shankaracharya formerly; now Shankaracharyas are to be found in every house. The gatekeeper's work is taken by the tailless dog, the wine merchants are getting rich and many new religious sects are coming into existence ".

In 1865 there was but one post office for the city of Poona and the cantonment and there was but one letter box in the centre of the city. One of the great grievances voiced in the newspapers in those days was the deficiency of letter boxes.

The public had in these days heard of the Swarajya that was lost, but had little idea of the Swarajya to come; and credit must be given to the late Mr. Justice M. G. Ranade for giving an idea of the political future of the country. The late Mr. Vishnushastri Chiplunkar unlike Mr. Ranade gave up his Government service in order to have the necessary freedom to pursue his objective. Tilak and Agarkar did not enter Government service at all. A brief account of some prominent citizens of Poona of this time is given below.

Mahadeo Shastri Kolhatkar — Learned Astronomy and Sanskrit Grammar at the Sanskrit Pathashala, established in Poona in 1821, and was later given a special scholarship to learn English under Major T. Candy. In 1851 when the Pathashala became the Poona College, Kolhatkar was appointed as the Professor of Marathi in the College. He died in 18. 5.

Gapal Hari Deshmukh — Was a towering figure of his time. He cannot be regarded as an author or a writer for most of his

writings are in the form of short notes over the pseudonym "Lokahitawadi". But a review of his writings could show what an indefatigable worker he was. Like Jotirao Fule, Deshmukh was also a target of criticism by Chiplunkar but the criticism was not appropriate. Convinced that his people had but little knowledge of the world outside and that one of the first things for them to do was to develop a wider outlook he did his best to place all he knew at the service of his countrymen. Even Chiplunkar had to admit that "Lokahitawadi has, as the name indicates, been a leader of all public activities in the last forty years. Even at the age of sixty he appears to have retained all the freshness of thinking and energy to act, to write and to speak as is seldom found even in young men".

Rao Bahadur Krishnaji Laxman Nulkar—adopted Poona as his place of residence after he retired from Government service in 1876. From the post of a personal clerk Mr. Nulkar had risen to the highest offices which in his time were within the reach of an Indian, and he was therefore an aquisition to the public life in Poona. More outspoken in his views and more independent in his action he was often put forward by a section of the Poona public as a worthy opponent to M. G. Ranade.

Mahadeo Govind Ranade — A great judge, scholar, economist, social reformer, and a liberal statesman of all-India reputation. May well be regarded as the premier citizen of this city. His life is too well known to need any record in a handbook. A point however which deserves special mention is that Ranade transferred his liberal views to his wife and Mrs. Ramabai Ranade after the death of her husband started and conducted the Poona Seva Sadan which from a small home-class for adult women has grown into an Institute with varied activities.

Ganesh Vasudeo Joshi—is another honoured name of this time. In or about 1869 Mr. Joshi felt the need of preaching the gospel of Swadeshi and immediately discarded his costly garments in favour of rough home made articles. He was a prominent worker of the Sarvajanik Sabha, Poona and was popularly known as Sarvajanik Kaka.

The History of a nation is often the history of its nation-building institutions and such institutions were just trying to raise their heads in this city. In 1871 when the Maharaja

Scindia visited this city it is recorded that he gave money grants to the following institutions: (1) Library (2) Normal School for women teachers, (3) A Girl School, (4) The beggars' home in Navi Peth, (5) A private English School, (6) Dnyanprakash and Dnyanachakshu Press, (7) Deccan College, (8) Sarvajanik Sabha, (9) Vaktritvottejak Sabha and (10) an association of Art Teachers.

This brings us to the days of Tilak and Gokhale and an account of the city and its activities from their time to this day will be found in the accounts of the many Institutions which appear hereafter.

THE CLIMATE OF POONA

Position and topography:—Situated on the western margin of the Deccan plateau and distant only thirty miles from the summit of the Western Ghats, the country round Poona is typical of the uplands of the Bombay Deccan, the monotony of which is broken only by flat-topped terraced hills. The general slope of the country is eastward with alternating low ridges and valleys. The region round Poona is drained by two streamlets, the Mutha and the Mula, which have their confluence in the City. The altitude of Poona is about 1800 ft. above mean sea level. Owing to its position in the *rain shadow* behind the Ghats the climate of Poona is dry during most parts of the year. On account of its elevation and dryness, Poona is cool during nights even in the summer.

Seasons:—As is common in this part of India, the year may be roughly divided into three seasons. The cold season from November to February, the hot season from March to May, and the wet season from June to October. The transition months of May and October immediately before and at the end of the monsoon are periods of thunderstorm activity. In the cold season dry easterly land winds prevail during most part of the day and cool westerly valley winds in the nights, and from January onwards there is an indraft of the sea breezes in the evening. By about the middle of March the temperature rises somewhat rapidly and hot breeze of variable direction prevails during daytime. Towards the end of April the temperature at Poona rises often above 100 °F. Thunderstorms occasionally alleviate the heat but the precipitation often renders the air uncomfortably sultry. About the end of May there is a peak in the thunderstorm activity which is occasionally associated with violent winds, sharp showers and hail. In June we get steady westerly winds throughout the day, and these mitigate to a considerable extent the summer heat. Finally these winds are replaced by the monsoon current.

The monsoon season, as being the period in which Poona is at its best, deserves special mention. Although clouded, there is always strong westerly breeze and it is pleasantly cool. The rain occurs in the form of light drizzles.

Rainfall:—There are three main sources of rain. The thunderstorms in May, the southwest monsoon between June and the end of September and the retreating monsoon of October. The monthly normals of rainfall and of the number of rainy days are entered in the following table.

	Jan.	Feb.	Mar.	April.	May	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Normal rainfall (in inches).	0·1	0·1	0·1	0·6	1·2	4·8	7·0	3·7	4·8	3·7	1·0	0·2	27·3
Normal number of rainy days.	0·2	0·1	0·2	1·3	1·8	7·6	12·3	9·0	7·5	5·2	1·7	0·5	17·4

The maximum falls are recorded in July. 75% of the annual rainfall occurs during the monsoon season. 18% of the total rainfall is due to the thunderstorms of May and October. The largest amount of rainfall recorded during 24 hours is 5·76″ which occurred in October 1892. The highest record of annual rainfall was 50″·91 in 1892. The frequency of heavy falls, entered in the following table, goes only to show how rare this phenomenon is.

Limit of interval.	3″ to 4″	4″ to 5″	5″ to 6″	6″ to 7″
Frequency. (based on 30 years' data).	11	3	1	—

Temperature :—In contrast to the maritime climate enjoyed by stations on the narrow strip of land west of the Ghats, Poona enjoys a continental climate. One of the chief features of this type of climate is the marked fluctuation of temperature. From a mean temperature of 69°F in December to one of 86°F in May is a change seldom met with on the coastal stations. The following table gives the normals of the maximum, minimum and mean temperatures and the mean range for the various months.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
Maximum tempera-ture.	86·1	90·6	97·1	101·1	99·7	89·6	82·8	81·7	84·6	89·1	86·8	84·7	89·5
Minimum tempera-ture.	54·2	56·2	62·8	68·9	71·9	72·6	71·0	69·6	68·6	66·5	59·1	53·9	64·6
Mean tem-perature.	70·1	73·4	79·9	85·0	85·8	81·1	76·9	75·7	76·6	77·8	73·1	69·3	77·1
Range.	31·9	34·4	34·3	32·2	27·8	17·0	11·8	12·1	16·0	22·6	27·1	30·8	24·9

From the lowest value experienced in December the temperature steadily increases until it reaches a maximum in April and May. The cooling due to the onset of the monsoon is observed from June onwards and a secondary minimum of temperature occurs in August. From September, the temperature increases due to the clearing of the skies, and in October a secondary maximum is attained. From November with the advent of the cold season the temperature steadily falls.

The average daily range for July and August is only half the range for the whole year. During the cold season the range is usually large; it reaches the maximum value in February, 10°F above the annual range.

Pressures:—The following table gives the mean monthly barometric pressures at Poona reduced to 32°F and standard gravity, and also the mean daily range, in inches of mercury.

	Jan.	Feb.	Mar.	April	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean monthly pressures reduced to 32°F and45 Lat	28·128	28·097	28·053	27·996	27·952	27·847	27·831	27·883	27 952	28·036	28·100	28·137	28 001
Mean daily range.	·135	·143	·143	·136	·117	·083	·066	·075	·099	·121	·122	·129	·114

The pressures are least in July and greatest in December in common with the Deccan plateau and north India. The daily ranges are greatest at the end of the cold season and at the commencement of the hot season. The minimum is met with in July.

Relative Humidity:–Its position on the side of the lee side of the Ghats makes the climate of Poona dry. The following table giving the mean relative humidities in percentage of saturation, for the various months substantiates this statement.

	Jan.	Feb.	Mar.	April	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Relative Humidity.	61	54	46	43	56	73	82	84	82	73	62	61	65

Even during the monsoon months the relative humidity of Poona is only slightly above 80%. During March and April it is considerably below 50%. The following quotation from the Bombay Gazetteer Vol. XVIII,Part I may be interesting as sum-

ming up the vaxations to which one is subject by the dryness of Poona climate. "The occasional extreme dryness of the air in December, January, February and part of March causes much inconvenience. Furniture cracks, doors shrink so that locks will not catch, tables and book covers warp and curl, the contents of the inkstand disappear and quill pens are useless unless kept constantly moist."

Cloud:–The mean cloudiness of the sky as estimated in tenths of the celestial hemisphere are entered in the following table.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean monthly cloud at 8 hrs.	1·3	0·9	1·0	1·4	2·2	6·5	8·0	7·6	6·4	3·6	1·9	1·4	3·5

The maximum occurs in July and the minimum in February.

Winds:—The most striking characteristic of Poona winds is their rareness from the south. The following table gives the percentage frequency of winds from the various directions of the compass.

	N	N. E.	E	S.E.	S.	S. W.	W.	N.W.	Calm.
January ...	5	3	8	5	1	6	17	25	29
February ...	5	3	5	4	4	15	15	19	31
March ...	3	3	2	4	3	17	22	22	24
April ..	2	1	3	4	1	11	39	24	14
May ...	1	0	1	2	1	2	60	20	5
June ...	1	0	2	1	1	19	57	14	5
July ...	0	1	0		1	25	63	4	6
August ...	0	0	0	0	0	23	62	10	5
September ...	1	0	0	0	0	16	59	14	10
October ...	7	4	9	5	2	7	18	16	32
November ...	7	11	15	5	2	6	8	12	33
December ...	6	9	22	5	1	4	8	13	32
Year ...	3	3	6	3	1	13	36	16	19

The most frequent direction in January and February is from the N. W.. due to the intensification of the high pressure over upper India. With the commencement of the hot season and the lowering of pressures inland, the direction slowly changes to the west. In October, though the wind is predominantly from the west and the N. W., winds from the other points are not uncommon. Easterly winds are most frequent in November and December.

Sea Breeze: Towards the evening, one notes in Poona, a sudden flow of air from west-north-westerly direction, on most days of the months of February, March, April and part of May. Its greater gustiness, humidity and lower temperature mark it down as the evening sea breeze. It is about 1 km. thick, near about Poona and seems to penetrate a considerable distance east of the station.

POPULATION.

The city of Poona as referred to in the census report of 1931 is a much bigger unit than what the words "City of Poona" ordinarily connote. It comprises five distinct areas of jurisdiction, namely Poona City Municipality, Poona Suburban Municipality, Poona Cantonment, Kirkee Cantonment, and Poona Suburbs. The 1931 Census enumeration of these units was as under:

Greater Poona.	Population.
1 Poona City Municipality	162,901
2 Poona Suburban Municipality	16,676
3 Poona Cantonment	35,807
4 Kirkee Cantonment	16,302
5 Poona Suburbs	18.501
Total population	2,50.187

Ordinarily "City of Poona" includes the first three and has thus a population of a little over two lakhs. Mr. Sedgwick remarked in 1921: "In the matter of birth-place Poona is not a particularly cosmopolitan place, Poona City Municipality is essentially old fashioned and is simply the hub of Maharashtra. Very few strangers from other parts of India will be found there. In the Cantonments and Suburban Municipality, on the contrary, conditions are more mixed and the Madrasi and Pathan is a common feature. The influence of the old fashioned City Municipal area which alone contri-

butes considerably more than half the total population of Greater Poona gives an impression of homogeneity in the populations which a casual visitor to the Cantonment bazar might consider misleading." The remark is true even to-day. If the cosmopolitan Cantonments and Suburban area be excluded from consideration, Poona will be seen to conform to the typical moffusil town with most of its population stay-at-home and home-born, and not supported by any organised industries conducted on lines of large scale production. Poona as contrasted with Bombay and to a smaller extent with Karachi, is essentially a residential and administrative headquarters town, on which has been super-imposed an important cantonment which has altered to some extent the original character and composition of the population.

The following statement shows the proportion of females per 1000 males.

Unit	Females
Poona City Municipality	877
Poona Suburban Municipality	740
Poona Cantonment	733
Kirkee Cantonment	640
Rest of Poona Taluka	697

This is just what one would be led to expect from the description of Greater Poona given above, except that the figures for the "Rest of Poona Taluka" are puzzling. The low rates of females in this unit can be understood only by a close examination of the population composition.

The distribution of the population according to religions per thousand:

Religion	City Municipality	Suburban Municipality	Cantonments	Suburbs	Greater Poona
Hindu	872	775	541	825	793
Muslim	93	116	199	109	116
Jain	12	6	19	2	13
Zoroastrian	1	23	48	12	13
Christian	18	76	188	49	60
Sikh	...	1	11	1	2
Jew	3	3	3	1	3
Other religions	1	...	...	1	...

As is remarked above Poona is not an industrial city. Its industries show no great bias towards any one type. Textiles are unimportant, and working in wood, metals, buildings, tailoring, and other occupations of the small individual and non-factory type, provide the majority of those engaged in industry, with a living. In this respect Poona presents features similar to those prevailing in Karachi and quite dissimilar to those prevailing in Bombay. The Military Arsenal and Ammunition Factory at Kirkee is the only establishment employing a considerable number of workmen under factory conditions. The number of persons shown as employed in "Insufficiently Described occupations" has been returned at 9,815. Most of these must belong to the class of general labour for which there is considerable demand in a place like Poona. The non-industrial character of Poona is proved by the fact that out of every 1000 of the population there are only 258 male workers and 52 female workers as against 690 dependents.

The literacy figures by religion and sex are as under.

City Municipality—(Total Population 86784 (M) + 76117 (F) = 162901)

Religion.	Literate.			Illiterate.			Literate in English.		
	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.
Hindu	34,957	11,227	46,184	40,338	55,490	95828	15395	2187	17582
Muslim	2878	360	3238	5543	6317	11860	661	43	704
Jain	942	113	1055	335	614	949	192	3	195
Christian	569	336	905	808	1251	2059	396	285	681
Zoroastrian	91	60	151	16	14	30	78	45	123
Others	172	121	293	105	199	304	122	100	222
Total ...	39609	12217	51826	47175	63900	111,075	16844	2663	19507

Suburban Municipality and Poona Cantonment:—

(Total Population $\overset{M}{30350}+\overset{F}{22325}=52675$)

Religion.	Literate.			Illiterate.			Literate in English.		
	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.
Hindu	5758	1162	6920	11872	12108	23980	1176	134	1310
Muslim	1934	475	2409	3427	3006	6433	679	89	768
Jain	492	63	555	168	251	419	79	1	80
Christian	2470	1449	3919	2738	2245	4983	2908	1577	4485
Zoroastrian	793	739	1532	538	708	1246	826	741	1567
Others	127	71	198	33	51	84	73	52	125
Total ...	11574	3956	15530	18776	18369	37145	5741	2594	8335

SOCIAL ACTIVITIES OF POONA.

BY

G. C. BHATE

Since the advent of British rule in these parts of India, Poona lost its importance as the metropolis of Maharashtra. However, it retained its position as an intellectual centre and with the rapid spread of western science and western culture among its intelligentsia, arose pioneers of public movements and makers of modern Maharashtra like Messrs. Ranade, Bhandarkar, Chiplunkar and Joshi of the first generation and like Messrs. Tilak, Agarkar, Gokhale and Karve of the second generation. These public leaders, in time, became the founders of great and abiding institutions. Hence a new visitor to Poona finds to his surprise and admiration that Poona is studded with a variety of institutions and societies.

In the description of these activities there, is bound to be some overlapping. For, though for the sake of convenience and due to the division of labour different public activities were separately carried on under different labels, the leaders knew and realised the essential interdependence and connectedness of all movements calculated to bring about the uplift and regeneration of a fallen nation. This fundamental principle cannot be better expressed than in the following often-quoted words of Ranade the apostle of these movements. According to him the true end and aim of social reform, (of which this note is to give a brief description) "is to renovate, to purify, and also to perfect the whole man by liberating his intellect, elevating his standard of duty, and perfecting all his powers. Till so renovated, purified and perfected we can never hope to be what our ancestors once were, the chosen people to whom great tasks were allotted and by whom great deeds were performed. Where this feeling animates the worker, it is a matter of comparative indifference in what particular direction it asserts itself and in what particular method it proceeds to work. With a liberated manhood, with buoyant hope, with a faith that never shirks duty, with a sense of justice that deals fairly with all, with unclodded intellect and powers fully cultivated, and lastly, with a love that ovrleaps all bounds, renovated India will take her proper rank among the nations of the world, and

be the master of the situation and of her own destiny. This is the goal to be reached—this is the promised land. Happy are they who see it in distant vision, happier those who are permitted to work and to clear the way on to it, happiest they who live to see it with their eyes, and tread upon the holy soil once more".

As stated in the parenthestis this note is intended to describe briefly the social activities of Poona. These activities were collectively called 'the social reform movement.' Of this movement Ranade and Agarkar were the Castor and Pollux. Ranade by his English pen and Agarkar by his Marathi pen roused the conscience of the people, made them realise the social evils obtaining among the Hindu people. The crux of the social reform problem in Hindu society was the position of women as regards education, child marriage and widowhood. All these questions were taken up by both Ranade and Agarkar. The question of widow remarriage was first agitated in Bengal by Ishwarchandra Vidyasagar and it was through his vigorous efforts that widow remarriage was declared legal by the passing of a permissive law by the Government of India.

This question was early taken up by Ranade with the collaboration of Vishnushastree Pandit. Vishnushastree Pandit not only did the propaganda work by writing and speaking in Marathi on the subject, but he also brought about an actual remarriage of a widow with a teacher, both the parties being Brahmins. This was felt as a challenge thrown by the reformers to the orthodox. So the latter excommunicated the promoters of the remarriage. This led to the famous debate on the Shastraic sanction to widow remarriage under the presidentship of Shrimant Shankaracharya of Sankeshwar. Though the debate ended in the defeat of the reformers by a small majority secured through pressure brought to bear upon some Shastrees who were really in favour of widow remarriage, it secured its purpose of opening the eyes of the public to the miserable and pitiable condition of child widows in Hindu society. Since then the Widow Marriage Association of Poona has been doing the work of popularising and helping the cause of widow remarriage. Later on this association was regenerated by Prof. D. K. Karve after his remarriage. It is now one of the living social activities of

Poona and is being ably conducted by Mr. Patankar a remarried gentleman and secretary of the said Association.

The problem of girls' education was the next problem tackled by Ranade and his collaborator, Shankar Pandurang Pandit. The visible fruit of the movement was the formation of the Maharashtra Female Education Society of Poona. This society at once started a high school for girls popularly known by the name 'Hujurpaga School'. because it was located at a place where there were formerly the *pagas* or cavalry lines of the Peshwas (*Hujur*). This School in time became a great educational institution and the female education society has now under its management, a primary school for boys and girls, a high school for girls and a Training College for primary school mistresses.

After having put the widow marriage association on a sound financial footing Prof. D. K. Karve turned his attention to the problem of the education of widows as distinguished from the problem of remarriage. His attention was forcibly drawn to this problem by the Poona Sharada Sadan (Home for widows started and conducted by Pandita Ramabai) becoming a purely proselytizing missionary institution. Prof. Karve, therefore, made his humble beginning by starting a small Widows' Home at Hingne outside of Poona. This was like a small seed. But this seed grew into the big tree of the Indian Women's University having many branches in the form of schools and colleges. Thus in and near Poona alone there are the following institutions: Mahilashram or Widows' Home; Primary School for boys and girls, college for primary teachers. All these are located at Hingne. Then there is the Women's College and University at Yerandavana and then there is the Girls' School in Poona. The singleness of purpose and untiring energy with which Prof. Karve worked for the emancipation of women from the thraldom of ignorance and custom has given to Poona the above mentioned institutions which have become its proud possessions.

Other institutions for the uplift of women owe their origin to the combined initiative and energy of Gopal Krishna Devadhar and the late Mrs. Ramabai Ranade. These social workers started the Seva Sadan Society of Poona. The object of this society was

to take up the education of grown up and married women. This society has now become a big centre of manifold social activities for the uplift of women. These activities are to be seen in the form of a High School for girls and widows, married women's classes for literary, artistic and industrial education, classes and boarding houses for preparing women to serve as school mistresses, nurses and midwives. The varied social activities of the Poona Seva Sadan for the general uplft of women of all grades and of all ages are on a vast scale and a visitor to these institutions cannot help admiring the self-sacrificing zeal and devotion of a host of social workers both men and women.

The Seva Sadan Society of Poona has not confined its activity to Poona alone, but it has started its branches of work in other places. Moreover, the society is sending forth social workers of both sexes endowed with the noble spirit of social service to society, to carry on similar work in the moffusil.

Another centre of social activity of great national importance in Poona is the Depressed Classes Mission Society of Poona. The guiding soul of this Society from its inception to its full development was the veteran worker Mr. Vithal Ramji Shinde. From small beginnings, Mr. Shinde was able to raise the mission's work to a great height. After having put the Depressed Classes Mission Society on a sound financial basis Mr. Shinde retired from his labour of love. The splendid work of the uplift of the untouchables now called Harijans, is being carried on by the co-workers and the followers of Mr. Shinde. This Society has a number of institutions to its credit and it has done a lot of good work not only in teaching the children of the Harijans of Poona, but also in spreading ideas of better living among the grown-up Harijans, who are persuaded to give up their evil and unclean practices and habits.

The above are the principal social activities of Poona to which the leaders of Poona can lay claim as their originators and founders. But there are many other minor activities carried on in Poona; where in some cases the Poona people have been working under the auspices of bigger societies and institutions started in India or even outside of India. In fact in these cases the Poona institutions are only branches of bigger ones— Temperance work, children's welfare work, orphanage work

morally fallen women's rescue work and similar work, are carried on in Poona by a number of institutions.

There are sectional societies, dealing, with social work in a particular section or caste of the people of Poona.

There are two more societies, one of recent origin and the other a little older, to which reference may be made in this descriptive note. The society for the improvement of sanitation and health of the Poona City and its people, called Arogya Mandal is a society devoted to social work. The guiding soul of this society was one Mr. Bhat. But unfortunately he died a premature death. The work, however, is being carried on by his co-workers though not quite with the vigour and perseverance of Mr. Bhat. The other society is the new novel organisation recently started by the enthusiastic social worker Mr. Bhagwat, Chief Officer of Poona City Municipality. This society is called " Poona in 1950" Society and aims at making Poona an ideal city by 1950. For attaining this purpose it meets now and then and discusses schemes and measures for improving Poona and then it tries to do propaganda work for the purpose of popularising such schemes and measures.

Institutions

Deccan Education Society:—The Society owes its origin to the New English School, which was started in 1880 by Messrs. Vishnu Krishna Chiplunkar, Bal Gangadhar Tilak and M. B. Namjoshi with the object of cheapening and facilitating education. Five other workers including Messrs. Vaman Shivram Apte, G. G Agarkar and G. K. Gokhale, soon joined the institution. Their efforts were crowned with unique success. This School was expanded into the Deccan Education Society in 1884 with H.H. the Maharaja of Kolhapur as President. The Society consists in addition to patrons and fellows, of a large number of Life-members. The object of the Society as stated when established was to "facilitate and cheapen education by starting, affiliating or incorporating at different places, as circumstances permit, schools and colleges under native management, or by any other ways adapted to the wants of the people." As soon as the Society was formed, the New English School was placed under its control. The first Council of the Society soon after applied to the Bombay University for permission to open an arts college in Poona. The University granted the permission provisionally for three years and the Fergusson College was formally opened on the 2nd of January 1885, with Mr. Apte as the first Principal For its description see a seperate note later on.

Both the New English School and the college were originally located in the City. With the object of having a separate permanent home for the college, the Council applied to the Government of Sir James Fergusson and after some negotiations, obtained the Nana Wada which at present houses the New English School.

In the meanwhile, the question of the amalgamation of the Government institution, the Deccan College, with the Fergusson College was raised by Government, but after long negotiations, the Society was obliged to decline the proposal, as the conditions proposed to be laid down were not acceptable. Thereafter the Society decided to utilise the Nana Wada site for the school only and to erect a

building for the college outside the town. The site for the latter, the present Fergusson College area was secured on 99 years' lease and the foundation-stone of the College laid in 1892. The appeal of the Society for funds for the college building was nobly responded to; and the present main building of the college, the Principal's bungalow and one residential block for 100 students named after H. H. the Thakorsaheb of Gondal who contributed Rs. 20,000 for the purpose, were erected. The main building was formally opened on the 27th March 1895.

All this time the New English School was growing and had acquired a name for excellent instruction in Sanskrit and Mathematics. The Gadre Wada was found to be insufficient and the Society had to face the problem of suitably housing the N. E. School. The Government having given the grant of the Nana Wada site, its material and Rs. 20,000 in cash, the Society thought of raising a suitable school house and collected the requisite additional amount of Rs. 1,25,000 by public subscriptions. The building was formally opened and the school moved to its new premises in June 1909.

In the meanwhile the necessity was felt of a Vernacular school, as a feeder to the lower standards of the New English School and in December 1898 the Society resolved to start one in the heart of the city. It was housed in the Holkar Wada kindly placed at the disposal of the Society at a nominal yearly rent by the Indore Darbar. In recent years, the school found its buildings insufficient and unsuitable and therefore the Society approached Government for a grant for suitable buildings. Government were pleased to sanction a grant of Rs. 1,25,000/-. and to acquire for the Society, land for playground, etc. The school is now housed in the new building.

The Society also decided to start an English High School at Satara in 1899. The School made a steady progress and the temporary housing arrangements were soon found to be inadequate. The Society therefore built its own building in 1908. The Society also took over the Dravid High School at Wai, in the course of expansion of its activities.

The Society also thought that the Southern Maratha Country was a suitable centre for University education, and

that there was a long-felt want for a college there. It accordingly proposed to start a college at Kupwad, a village in British territory and within easy reach of the towns of Sangli and Miraj, and approached Government and the Chiefs and the public of the Southern Maratha Country. It received a cheerful response from all sides. His Excellency Lord Willingdon who was then Governor of this Presidency, took a keen interest in the scheme and the College was named ofter him.

At present the Society is running the following institutions, (numbers in brackets after name indicate in round numbers the pupils on the roll in 1932-33.):—

(1) Fergusson College (1550), (2) Willingdon College (400), (3) New English School, Poona (1700), with a Hostel (40), (4) New English School, Satara (800), (5) Navin Marathi Shala, Poona (625), (6) Mawji Madhavji English School, Umbargaon (75), (7) Dravid High School, Wai.

Shikshana Prasarak Mandali:—The Shikshana Prasaraka Mandali was founded as early as 1883, by a small but devoted band of primary teachers at Poona to commemorate the first anniversary of the late Vishnushastri Chiplunkar, one of the pioneers in the field of modern Marathi literature. The Mandali has all along been fortunate in securing workers of outstanding qualifications, who, satisfied with a living wage, have selflessly devoted their lives to the cause of education. Starting in the nineties of the last century with the very humble beginning of a few primary classes taught by Life-workers working on a remuneration of less than Rs. 10/- per month, the Mandali has slowly but steadily kept on advancing, so that in 1896, the Mandali's first High School, the Nutan Marathi Vidyalaya at Poona, sent its first batch of 11 students for the Matriculation, and not only did every one of them pass the Examination but one of the students, the late Dr. V. S. Ghate, secured the coveted honour of the First Jagannath Shankershet Scholarship. In 1916, twenty years later, the Mandali started its Arts College at Poona. One of the principal aims of the Mandali is the popularising of higher education wherever possible; and true to this ideal, in response to the request of the leading public of Sholapur, the Mandali took over in 1918, the New English School at Sholapur from Mr. R.

B. Apte, renamed it as Haribhai Deokaran High School in grateful acknowledgment of the handsome donation of Rs. 27,000 - from Shet Hirachand Ramchand Gandhi on behalf of the firm of Haribhai Deokaran & Sons, and developed the Anglo-Vernacular School into a full-fledged High School.

In 1920 the Arts College sent its batch of graduates. In 1924, the Mandali started an institution which is perhaps unique in the whole of India, the Mimansa Vidyalaya, an institution for the preservation and study of ancient lore. In 1926, the College had a magnificent building of its own on an extensive area of 28 acres of land. In 1927, the Science department was added and today the College offers instruction up to M. A. and M. Sc. standard. In 1928, the Chiefsaheb of Jamkhindi with a view to perpetuate the memory of his revered father, the late Sir Parashurambhau Patwardhan, offered to the Mandali a generous donation of rupees two lakhs and the Mandali named the College as Sir Parashurambhau College and offered to teach 50 Jamkhindi students free of all tuition fees. Since 1931, the Mandali is conducting a Book-stall at Poona which stocks the best and the latest books and brings out useful publications of educational interest. In 1933 the Mandali started a School of Commerce.

The educational activities of the Mandali have thus evolved from small beginnings. Today the Mandali has, in all its institutions, over 4500 students and over 185 members on the teaching staff.

Hindu Widows' Home Association. — Professor Dhondo Keshav Karve started the Anatha Balikashram in Poona in 1896, in order to educate young, poor and deserving Hindu widows, so as to make them self-reliant and useful to society. In the year 1900, during the plague epidemic, the late Rao Bahadur Ganesh Govind Gokhale offered to place some of his land in the village of Hingne Budruk, situated at a distance of about four miles from Poona, at the disposal of the institution. A mud hut, which is still to be seen, was built on this site and the Home was established there. A number of unmarried girls were attracted to the Widows' Home, and a new school named Mahila Vidyalaya had to be started for these in 1907 in the city. Great efforts were made in order to induce parents not to

marry their daughters till the age of 20 and to educate them. This school flourished in Poona till 1912 when it was also removed to Hingne. In 1915 both these were amalgamated, and the Hindu Widows' Home Association became a general institution for the education of girls, married and unmarried women, and widows.

At present there are at Hingne the following departments, all expanded around the nucleus of the mud-hut of 1900 in the course of a generation:—(i) high school, (ii) training college for primary teachers, (iii) primary school with separate special classes for adults, little girls and rural children. In these there are altogether about 220 pupils. About 180 girls (60 widows, 30 married and 90 unmarried girls) of all Hindu sub-castes from the age of 5 upto the age of about 30 years, stay in the three hostels conducted at Hingne. About 60 students are maintained free or half free by the Association.

The Association has depended all along on public support. So far it has received some annual help from the Women's University which began at Hingne in 1916 but was later, on expansion, removed to its own grounds at Yerandawane. The Government of Bombay has recently started giving a little annual grant. The Association at present owns about 13 acres of land together with buildings worth about 1½ lakhs of rupees.

The institution has so far sent out more than 150 trained teachers, while many nurses, midwives and doctors have received their preliminary education in this institution, and has helped hundreds of women to secure means of independent livelihood.

Indian Women's University. The University was founded by Prof. D. K. Karve in 1916 with the following aims and objects:—

(*a*) To make provision for the higher education of women through modern Indian Languages as media of examinations and instruction by starting, aiding, and affiliating institutions for such education.

(*b*) To formulate and lay down Courses of Studies specially suited to the needs and requirements of women.

(*c*) To institute and confer Degrees and Diplomas, etc., as may be prescribed by the regulations.

The conduct and governance of the University is vested in a Senate of 60 Fellows elected by different Electorates, and the Executive is formed of the Chancellor, the Vice-Chancellor, Principals of the affiliated Colleges, the Registrar, and seven elected Syndics.

The University is conducting one College at Poona and one at Bombay and two Colleges, one at Ahmedabad and the other at Baroda, are affiliated to it. There are two High Schools one at Bombay and the other at Poona conducted by the University and 18 schools working along the lines laid down by the University. The total number of students studying in all these schools numbered over 2700 in 1933. About 50 students are studying in the Training College affiliated to the University.

The University has so far turned out 113 Graduates, five 'Proficients in Arts'; 1 candidate has taken a Diploma in Teaching. Nearly half the Graduates are working in the cause of women's education by starting schools in different district towns.

The University is not recognised by Government, and does not receive any help from the Bombay Government or the Government of India. Some of its schools, however, receive grants from the Department of Public Instruction and also permission has been given to its Matriculates and G. A.s to appear for the S. T. C. The Training College Certificates issued by the University are given the equivalence of the Government Certificates. The College of Physicians and Surgeons has given recognition to its Entrance Examination.

On 21st June 1920, the late Sir Vithaldas D. Thackersey promised to give to the University Rs. 15 lakhs in 3½% Government Pro. Notes on fulfilment of certain conditions and until the fulfilment of all the conditions laid down, the University was to receive the interest, Rs. 52,500/-, on the Corpus of Rs.15 lakhs. One of the conditions, which was done immediately, was to name the University after the name of the Donor's mother, Shreemati Nathibai. According to the Will of the late Sir Vithaldas, the University has been receiving Rs. 52,500/-every year from the Thackersey family. Since March 1932, the Thackersey family has stopped paying the interest and hence for the time being the University

is experiencing extreme financial stringency. The permanent Fund of the University on 1st January 1933 was nearly one and a half lakhs of rupees, in addition to its property at Poona worth about Rs. 350000/-

Students are admitted to the University on passing Entrance Examination or Matriculation of any Indian University recognised for that purpose. The following degrees and certificates are awarded by the University:-Degrees: 1. Graduate in Arts (G. A.) and 2. Proficient in Arts (P. A.). Diploma: (1) Diploma in teaching Certificates :-(1) The Entrance Examination Certificate, (2) The Secondary School Certificate, (3) Certificate for the Primary Training College Examinations, (4) Certificate after the completion of the Certificate Course for the Collegiate Studies, (5) Certificate in individual subjects.

Seva Sadan Society. — After his travel in northern India in 1908 in connection with famine relief work, Mr. G. K. Devadhar realised the necessity of women social workers. The establishment of the Seva Sadan was a result of this idea taking root in Poona. As a result of the discussion by interested social workers, among whom the late Mrs. Ramabai Ranade was prominent, it was decided to take in hand the education of a few young poor widows, who were keen on getting themselves educated with the double object of enabling themselves to stand on their own legs and also to do some social service at the same time. The Poona Seva Sadan started its actual work in October 1909 with two literary classes having only about a dozen women students. It may be remembered here that the Bombay Seva Sadan was already established in Bombay by that great philanthropist and social reformer Mr. Malabari, and the late Mrs. Ramabai Ranade was its president. The Poona Seva Sadan Society was, at its commencement, started as a branch of the Bombay Seva Sadan Society.

Gradually, however, the needs and scope of work of the Poona Seva Sadan increased considerably and the Bombay Seva Sadan found itself unable to shoulder the responsibilities of the Poona institution. The Poona Branch was therefore registered as a separate body in 1917. The aim of the Society has been to carry on its activities on strictly non-sectarian and non-sectional lines. The Society developed

rapidly into a large organisation, promoting, through a wide-spread net-work of its branches, education and training of different kinds to enable poor women of all castes and creeds in particular, to take up vocations such as lady doctors, nurses and midwives, Public Health visitors, governesses, teachers, sewing and weaving mistresses, needle craft workers, music teachers etc.; and training them to render educational, medical and philanthropic service specially in backward areas, and on occasions of wide-spread public distress and national calamities like flood havoc or famines.

Among the principal institutions of the Society at Poona are, Bai Motlibai Wadia Training College with Practising School for girls; primary education classes for adult women; classes for First Aid, Home Nursing etc., High School Classes; work-room or Domestic Industries such as Sewing, Embroidery, Hosiery, Weaving, Toy-making, Composing and Printing; Sewing Classes; Music Classes; Nursing and Midwifery instruction at Sassoon Hospitals; Medical Instruction for L. C. P. S. course at B. J. Medical School and Sassoon Hospital; Public Health School, and Infant Welfare Centre. The Society runs about half a dozen hostels for lady students for the various branches of instruction mentioned above. It also maintains a Maternity Home.

The Society has started recently a new experiment in "Rural Uplift". It has opened a centre at Khed-Shivapur, about 15 miles from Poona. A Reading Room, Night Classes for villagers, Vyayam Shala for physical culture. Agricultural demonstrations etc. are conducted by the students and teachers of the Society, with the assistance of the officers of the Government Department of Agriculture. Medical advice and treatment are also given at the Centre by a fully qualified mid-wife. The Lady Doctor of the Headquarters is always available to give advice.

Fergusson College:—The Fergusson College owes its origin to the development and growth of the New English School, Poona, founded in 1880 by the late Vishnu Krishna Chiplunkar and Messrs. B. G. Tilak, G. G. Agarkar and M. B. Namjoshi for the purpose of cheapening and facilitating education. Gradually several other gentlemen joined the staff of teachers with the

object of devoting their lives for the work, and the body thus formed felt that they were in a position to take a higher step. Before doing so, however, they called a meeting of the sympathisers of private education on the 24th October 1884, and this meeting formed themselves into the "Deccan Education Society" for the purpose of carrying out the original objects of the promoters of the New English School. Soon after, the Council of the Society resolved to start a College under the name of the " Fergusson College " to mark their appreciation of the interest which His Excellency the Right Honourable Sir James Fergusson, Bart., Governor of Bombay, took in the cause of private education generally and in the growth and prosperity of their school in particular ; and on their application, the College was recognised in the Faculty of Arts for the purposes of the Previous Examination on the 13th December 1884. Further developments afterwards took place and at present the College is recognised in the whole Faculty of Arts and Science.

The College is under the direct control and supervision of the Governing Body of the Deccan Education Society which consists of five non-life member representatives of the Council and three representatives of Life-members. The permanent funds of the Society are under the control of the Council of the Society.

The permanent funds of the Society including sums subscribed and realised up to date and building grants from Government amount to about eleven and a quarter lakhs of rupees. Of this sum by far the greater part has been spent in buildings and other immovable properties for the use of the various institutions of the Society. Buildings, etc., that are used for the College are as follows:—

(1) The main College buildings opened by Lord Sandhurst on the 27th March 1885 consisting of ten large sized rooms and a big Hall.

(2) The Wadia Amphitheatre (opened by Lord Sydenham in 1912) and the adjoining lecture halls, consisting of the large amphitheatre to accommodate an audience of about two thousand, two large sized class rooms and eight small sized lecture rooms ; the trustees of the N. M. Wadia Charities contributed Rs. 25,000 for the Amphitheatre and the remaining cost of about

Rs. 75,000 was met out of Imperial and Provincial Government grants and public subscription.

(3) The Kashinath Waman Kane Chemical Laboratory built in 1904 to which a lecture hall and an additional laboratory hall for practical work have been added.

(4) The Physical Laboratory consisting of a demonstration hall, a large hall for practial work, a dark room, and several other rooms built out of the Imperial grant.

(5) The Savai Tukoji Rao III Maharaja Holkar Biological Laboratory for which H. H. the Maharaja Holkar contributed Rs. 20,000 and which was opened by Lord Willingdom on 20th June 1916.

(6) The Sir Shapurji Broacha Students' Reading Room and Library built out of a donation of Rs. 10,000 from Sir S. B. Broacha and opened on the 20th of June 1916.

(7) The Sir Bhagwatsinghaji quarters for students opened along with the main building of the College on 27th March 1895 named after the H. H. the Thakoresaheb of Gondal.

(8) Another large hostel opened in 1915 built mainly by means of a debenture loan.

(9) Another hostel for 100 students built mainly by means of donations from Messrs. Tulsidas Tejpal and Madhavji Hariram of Bombay.

(9*a*) An additional hostel for 80 students belonging to communities backward in education opened in 1925 was built mainly by means of donations from the public and the Government grant, thus giving a hostel accommodation for about 420 students.

(10) Hostel for lady students accommodating about 35 lady students.

(11) Quarters for the Principal and eight resident professors on the College grounds.

(12) A botanical garden extending over about two acres and a half.

(13) The provision for the Athletic training of the students consists of large cricket and football grounds, with a pavilion and gymnasium on the college compound, an extensive play-ground with eight tennis courts.

(14) Thanks to the munificent donation of Sir Ness Wadia and Mr. C. N. Wadia, a fine separate building–the Bai Jerbai Wadia Library–has been constructed for the housing of the Library, with adequate shelving equipment. There is already a collection of over 40,000 books, and every year the College spends Rs. 5000 in making additions to the existing stock. The Building has a spacious hall reserved for reading purposes which can accommodate 270 students at a time. The Library which is fitted up with electric light is kept open from early morning to ten in the night. Complete arrangement exists for students and staff.

(15) A hospital with provision for four beds has been built a few year ago.

Deccan College.—On the occupation of the Deccan by the British Government in 1818, it was found that a certain portion of the revenue of the Maratha State had been yearly set apart for pensions and presents to Brahmans (Dakshina). To prevent hardship and disappointment, the British Government continued these payments; but as the pensions and allowances fell in, they resolved to devote a portion of these to a more permanently useful end, in the encouragement of such kinds of learning as the Brahmans were willing to cultivate. With this view the Poona College was founded in 1821 as a Sanskrit College.

In 1837, some branches of Hindu learning were dropped, the study of the Vernacular and of English was introduced, and the College was opened to all classes; and after having been amalgamated with the English School in 1851, it arose in its present form in 1857, by a separation of the College Division from the School Division. In 1860, it was affiliated to the University of Bombay.

In 1863, Sir Jamsetji Jijibhoy, Bart., offered to Government the sum of one hundred thousand rupees to provide suitable College Buildings for the Deccan College.

In March 1868, the new buildings were occupied, and the Government directed that the name of the Institution should be changed from that of the Poona College to the Deccan College.

In 1927 laboratories for teaching the Science course of the Bombay University were added, and were formally opened by His Excellency Sir Leslie Wilson, Governor of Bombay.

For reasons of financial stringency, it has been decided to close down this College from March 1934.

Sir Parashurambhau College:—The " New Poona College " had its origin in the growth and development of the " Nutan Marathi Vidyalaya " which was started on 1st January 1883 by a few earnest workers to perpetuate the memory of the late Mr. Vishnushastri Chiplunkar by spreading and facilitating intellectual, moral, physical and scientific education through the medium of Marathi. This band of workers belonged to the Poona Training College for Men and was thoroughly imbued with the idea that in order to have a sound superstructure capable of additions and expansion it was essential to begin careful and methodical work at the very place where the foundations of future greatness are laid. They, therefore, commenced the really arduous task of imparting instruction in the lowest Vernacular Standards. As the founders received energetic and capable colleagues into their body and the Vernacular Standards gained in strength, efficiency and popularity, English came to be gradually introduced into the upper standards. This process of development from within went on steadily until there grew up by the end of 1895, a full-fledged High School out of the original Marathi School.

In the meanwhile the original founders, and their new colleagues, thinking it desirable to place their body on a permanent footing under the guidance of men of light and learning, and to give it a regular constitution, called a meeting of their friends and sympathisers on 5th February 1888, at which the Society named the *Marathi Shikshana Prasarak Mandali*, now called the *Snikshana Prasarak Mandali*, was formed. It was then registered under Act XXI of 1860 on 12th March 1888. The Mandali took under its management the Nutan Marathi Vidyalaya with a view to carry out the original objects of the promotors of the Institution and under the direction of its Council the Institution grew and flourished in the manner aforesaid. The Nutan Marathi Vidyalaya High School, having well stood the test as a public educational Institution for 20 years,

the Council of the Mandali thought that their Institution had reached a condition in which a College might be usefully added to it for the permanent well-being, stability and perfection of the original Institution as much as for meeting the growing demand for another College in Poona. The Council, therefore, applied to the University for the affiliation of the Second Grade Arts College which they proposed to start on behalf of the Mandali and which they intended to develop early into a first Grade Arts College. The Senate having recommended that affiliation might be granted for a period of five years for the purpose of the First Year's Course and the Intermediate Examination in Arts, Government were pleased to sanction the same in 1916.

The New Poona College was at the start located in the City in the Mandali's New building, which was opened by His Excellency Lord Willingdon on 14th June 1916, and regular work commenced after Dr. Sir Ramkrishna G. Bhandarkar had delivered his inaugural address on 20th idem.

In view of the steady growth of the College, and the desirability of adding the Science side to it to make it complete, the Managing Council decided to go in for a separate three-storied building for the College outside the City on the Baba Maharaj grounds, measuring about 25 acres, which the Mandali had taken on lease for a period of 99 years since 1918. In June 1926 the building was only half finished when the College was removed to its permanent home, and the work of construction was over on the 20th June 1927, when His Excellency the Governor of Bombay, Sir Leslie Wilson, declared open the College Building along with the Inter. Science Class and the College Hostels built on the premises.

The College is under the management of the Mandali's Council which consists of 9 non-Life-members elected from amongst the Patrons, Benefactors and Fellows (*i. e.*, persons contributing Rs. 500 and over, Rs. 250 and over but less than Rs. 500, and Rs. 100 and over but less than Rs. 250 respectively) of the Manadli and 5 Life-members elected by the Mandali's Board of Life-members. The permanent funds of the Mandali are under the direct control of the council of the Mandali.

The Chief Saheb of Jamkhandi, Shrimant Appasaheb

Patwardhan, who takes a very keen and personal interest in the institutions and activities of the Mandali, has been the President of the Mandali since February 1927.

In June 1928 the Chief Saheb of Jamkhandi, to perpetuate the memory of his beloved father, Sir Parashurambhau Patwardhan, and to help the Mandali financially at a time when its needs were multifarious, offered to give to the Mandali a sum of two lakhs of rupees, and the Mandali in return agreed to change the name of the College to "Sir Parashurambhau College."

College of Engineering:—The College of Engineering has developed from "The Poona Engineering Class and Mechanical School" which was opened in July 1854 in Bhawani Peth, Poona City. This school was started in order to provide subordinate officers for the Public Works Department. In the same year Government proposed the establishment of an Engineering College for this Presidency and one point that had to be considered was whether the College should be attached to the Elphinstone College in Bombay. Eventually Poona was decided to be a better locality, in order to take advantage of the Military School run in connection with the Sappers and Miners. At this time the G. I. P. Railway had not been started.

In 1866 the College was affiliated to the University of Bombay for the degree of Licentiate of Civil Engineering, and two years later it moved from Poona City to new buildings erected on its present site. In the main hall is the following inscription:—"To assist in providing a new profession for his fellow-countrymen, Cowasjee Jehangir Readymoney, Esq., presented to Government the sum of Rs. 50,000 towards the erection of this building, July 1863."

The first student qualified for the degree of L. C. E. in 1868, and in the same year Government instituted the system of guaranteed appointments under which there were three appointments annually to the upper and three to the lower subordinate establishments of the Public Works Department. These have been continued ever since, but they will be withdrawn from 1935, after 67 years, probably on account of the financial difficulties of the present times.

The University course was remodelled in 1872, and Architecture and Mechanical Engineering were added as optional subjects. The Workshops were completed in the same year. Five years later two new classes, an Agricultural and a Forestry Class, were added and the name of the institution was changed to "The College of Science." In 1887 the College of Veterinary Hospital was opened and the following year the Takhtasingji Astronomical Observatory was commenced. Later this observatory housed a Grubb's 16½ inch reflecting telescope in a 20 foot dome. In the following year the Bacteriological Laboratory was built.

The Agricultural Classes were taken away from the College of Science in 1907. Two years later the University of Bombay revised the Engineering Courses and instituted the degree of Bachelor of Engineering (Civil), and after the lapse of another two years the Institution again changed its name to "The College of Engineering, Poona," the designation it now holds. The degree in Mechanical Engineering was instituted in 1913, but it was not until 1932 that students were admitted to the courses leading to the degree in Electrical Engineering.

Throughout its existence, there have been additions to the accommodation and the equipment. Periodically the courses have been modified to meet the changing needs of the times. 70 Students are admitted annually to the Degree Classes, and 80 to the Diploma class. There are usually about 450 students on the rolls.

College of Agriculture:—The initiation of higher agricultural education in the Bombay Presidency dates from the year 1878. At that time, partly as a result of one of the most severe famines of the nineteeth century, general attention was turned to the possibility of increasing the resistance power of the country to famine by an improvement in the agricultural methods in practice. As a result, classes were founded at the College of Science, Poona. At first the course was elementary. In 1880, a farm, ultimately made up to seventytwo acres, was acquired near the College of Science for the instruction of the students. In 1897, the standard of admission to the course was raised from the "Matriculation" to the "Previous" Examination. A further change took place in 1899. The Diploma course had long been evidently unsatisfactory, and a general demand

existed for an agricultural degree, to be given by the Bombay University and the University consented, and established a regular course leading to the degree of Licentiate in Agriculture, with a revised and thorough course.

The growth was however, so rapid from 1900 to 1905 that the accommodation available at the College of Science became very insufficient and an establishment of an entirely separate institute for agriculture was considered by Government. The result of this consideration was the complete separation of the Agricultural classes from the parent institution on January 1st 1908 and the establishment of the Poona Agricultural College. A fine site for the College and the farm of nearly 150 acres was secured and the buildings required for teaching the students' quarters and the chemistry block being completed, the whole College was transferred to it in May 1909; the main building, the large College Hall, Museum, Herbarium and adequate facilities for teaching and research in Agriculture, Botany, Mycology, Entomology etc. were finished in 1911 and occupied. The total cost of the College Buildings, Farm Structures and Residential Buildings was approximately rupees seven and half lakhs. The buildings were formally opened by His Excellency Sir George Clarke, Governor of Bombay, early in July 1911.

While awaiting the completion of these buildings, the College was temporarily located in a series of houses at Kirkee which had been adapted for College purposes.

Coincidently with the complete separation of the Agricultural College from the College of Science, the Bombay University made a further change in the course for the degree. The scope was extended, the standard raised and the graduates from 1909 began to have the degree of Bachelor of Agriculture. In 1916, acting on the report of its specially appointed committee, the University passed revised regulations for the Examinations in Agriculture. A degree of Master of Agriculture was also instituted in that year. This degree has been deservedly popular especially among men working as graduate assistants in the department and is a definite stimulus to investigation.

The course on the whole worked well, but it was found that the optional subjects were taking up rather too much of students'

time. Hence the next change introduced in 1925 was to increase the number of optional subjects by subdividing some of the old ones to devote less time to them in the curriculum. At this stage also Agricultural Engineering became a major subject for the degree examination and Advanced Agricultural Economics was introduced amongst the new optional subjects.

From April 1916 to April 1919, the main building of the College, students' hostel and the Professor of Agriculture's bungalow were utilized by the Military Department as the Deccan British War Hospital.

The College is under the direct control and supervision of the Director of Agriculture, Bombay Presidency. The executive charge is vested in the Principal.

Each Department possesses good laboratories and other facilities for teaching and research. The most important of the other facilities are:—

(a) The College farm which has been extended to an area of 306 acres furnishes practical training and demonstrations and also land for the research work of all the branches making up agriculture. It possesses a comprehensive museum of Indian and foreign agricultural implements.

(b) The Agricultural College Dairy having a fine herd of about 100 cows and buffaloes and a farm of 65 acres where fodder crops are grown is situated nearby; there is another area of 278 acres, about 11 miles from the College where dry cattle and young stock are kept and fodders grown. The Dairy besides carrying on improvement of the breeds also furnishes an object lesson as a commercial concern supplying hygienic milk and milk products to the public.

(c) A well equipped Veterinary Hospital under an experienced officer of the Veterinary Department, situated near the Engineering College Hostel within an easy reach from the College, treating indoor and outdoor patients, furnishes practical training to the students. The Hospital was renovated in 1930 from the generous donation of Rs. 30,000 given by Bai Sakarbai Nusserwanji Anklesaria and is named "The Nusserwanji Sorabji Veterinary Hospital." The Hospital is very popular with

the public for the treatment of cattle, horses, dogs, sheep and poultry.

(d) Two Orchards, one the Modibag forming a part of the College grounds and the second called the Ganeshkhind Botanical Garden about 3 miles from the College furnish the practical training for the students.

(e) The Agricultural Engineer's Workshop situated on the College estate is also used for the practical training of students in Engineering, Water lifts etc.

Law College :—Towards the end of the last and the beginning of the present century a general desire existed for a Law Academy under independent private management, and an attempt was made by prominent leaders in Bombay for the initiation of a Law College, but it did not succeed. The students however very keenly felt the want, and Messrs. J. R. Gharpure and P. B. Shingne decided in the winter of 1902 to make a beginning in that direction. The New Law Class, Bombay, was, therefore, started in 1903 wherein provision was made for giving instruction to students preparing for the Pleaders' Examination held by the High Courts and the Chief Courts and, also to the University students of Law by private arrangement. A library was started where students were reading under the supervision of the staff. The next stage was reached in 1907 when on an application by the Deccan Education Society, the Fergusson College Law Class was affiliated for the purpose of the First LL. B. Examination, and Mr. J. R. Gharpure was placed in charge of the same. Soon after, however, the University decided upon the policy of concentrating legal study in Bombay, and as a result all the Law Classes in the mofussil came to be disaffiliated. The experiment thus started at Bombay had a trial for over fifteen years, and it was found that there was room for supplementary efforts. Accordingly, with the concurrence of lawyers in Bombay, Poona, and outside, a Society called the Indian Law Society was established at Bombay on the 4th of March 1923 with the late Dr. Sir Narayanrao Ganesh Chandavarkar, Kt., B. A., LL. D., as its president. Mr. H. C. Coyajee, B. A., LL. B., Advocate, High Court, is its present president. Members are divided into Patrons, Fellows, Associates and Working Members. The working members pay a contribution

and are pledged to work at the College for a fixed period. The objects of the Society are, among others, the following :—

(*a*) To provide facilities for the study of law by starting colleges at various centres in the country, where law will be taught and may be studied as required by the curricula of the several Universities and High Courts, and on a scientific basis.

(*b*) To open schools for imparting a general knowledge of law to citizens.

(*c*) To make provision for imparting instruction in law and constitution to those who require it for qualifying themselves for any special purpose, and to do all such things as would further the said objects.

In pursuance of these the first step taken by the Society was the opening of a Law College at Poona, which was decided upon at its first meeting and was finally affiliated in December 1923. The College was opened in June 1924 and the response that it received and has ever since been receiving, has made it clear that such an institution was a long felt want. The College classes are temporarily held in the premises of the Deccan Education Society's Fergusson College where also is located the Library for the students. A large plot of ground has been negotiated for where the main building of the College, with the Library, the Residential Quarters for the Principal and the professors and the students, the Gymkhana Pavilion and the Platoon Headquarters of its University Training Corps platoon and other buildings will be located. The College has Gymkhana arrangements for all sports.

Modern Education Society:—established in 1932 for the spread of primary, secondary and higher education among the younger generation. The Society consists of life-members, benefactors, patrons and fellows and the management is vested in the senate, academic council, finance council and the board of life-members. The Society is at present conducting the Wadia College in Poona (Camp) and is considering plans for the establishment of other institutions in and outside Poona.

Training College for Men.—It is one of the oldest Government Institutions in Poona. It is an off-shoot of the Sanskrit Pathashala established in Poona in 1826. In 1821 a Normal class was opened in the Sanskrit Pathashala and that developed

into the present Training College for Men, after passing through various stages of development. Earlier than 1851 English was introduced in the Sanskrit Pathashala and that developed into the present Deccan College. The Training College had many renowned Principals. The Institution prepares teachers for vernacular schools in the whole of the Marathi speaking districts. The College has a two years' course after the completion of the vernacular education. Before a student is admitted to this College he should have passed his Vernacular Final examination. There is a big Practising School attached to this College. It is a day Primary School where about 400 boys and girls take education. The teachers under training are required to stay in a hostel attached to the College. The Institution has well laid out gardens and very impressive buildings. The present number of teachers under training is 195. There are four divisions of the first year and one division of the second year. The compound of this Institution is situated on the main road in the Sadashiv Peth.

Maharashtra Girls' Education Society.—Is one of the oldest institution for the education of Indian girls and was established in 1884. The number of girls which was 40 in that year increased to 617 in 1933. The High School conducted by the Society was largely supported by Government by the supply of teaching staff from the Department of Public Instruction. It has however been decided to transfer the school entirely to the Society during the course of the next few years. A large number of past students of this School are doing valuable social work all over India.

Maharashtra Education Society:—is one of the oldest educational institutions. It conducts a high school in the city and another in the Deccan Gymkhana and thus successfully supplies the needs of the western part of the city as also of the newly developed suburbs beyond the Lakdi Bridge.

Queen Mary's Technical School for Disabled Indian Soldiers:—This School was established in Bombay through the efforts of the Countess of Willingdon. The School is maintained by public donations and subscriptions from Ruling Princes, War fund and other funds. It was opened by His Excellency the Governor of Bombay on 16th May 1917 and was transferred

to Kirkee on 1st March 1922. It is situated on the site of the artillery position in the famous battle of Kirkee in 1817.

The object of the School is to take over for a period of six months or more, soldiers and followers of the Indian Army, Imperial Service Troops and Royal Indian Marine, of all ranks and classes who have been invalided out of the Service as unfit for further military duty. Only those invalided from the Service are eligible for admission.

The School provides them with free passages, uniform, food, bedding and other necessaries and teaches them trades, so that after a course of training they have means of supplementing their pensions, and living in comparative comfort. An allowance of Rs. 6, per mensem is also given while under instruction.

Each man is at liberty to select the trade he wishes to learn provided he is physically fit. After he has undergone the prescribed course of instruction he is examined, and on passing the examination is provided with a diploma.

The following trades are taught, each class being under the charge of an experienced Instructor: (1) Motor Car Driving ; (2) Oil Engine Driving ; (3) Tailoring ; (4) Hosiery Knitting ; (5) Hand-loom Weaving.

Shivaji Maratha Society: — Established in 1918 for the purpose of spreading primary and secondary education among the Maratha community and to remove the causes of the social and educational backwardness of that and other similar communities. The Society conducts a high school in Poona as well as a hostel for students of the Maratha community, and two primary schools.

Camp Education Society:—was founded in 1882 with the object of educating the children in the Poona cantonment area. Till 1922 it conducted an Anglo-vernacular Middle School and a Primary School with Gujarati and Marathi sides. In 1922 it was developed into a full High School and has been, since then, steadily growing in size and reputation. It has a branch school in Rasta Peth which is on the border of the city and the cantonment areas. Out of about 800 students reading in the schools conducted by the Society 80 % belong to the backward classes.

Depressed Classes Mission Society.—is the principal Society in Maharashtra for the uplift of the so-called depressed classes, especially the untouchables. It was established in 1806 by Mr. V. R. Shinde, an ardent social reformer and a member of the Prarthana Samaj. This institution has done very valuable work in connection with the education and sanitation of backward communities and maintains a boarding house, a school and a dispensary in Poona.

Byramjee Jeejibhoy Medical School:—This institution was the outcome of a severe epidemic of relapsing fever that made the Bombay Government realise the necessity for increased medical aid in the Presidency. As the name of the School indicates, its foundation was in part due to the munificence of Mr. Byramji Jeejibhoy, C. S. I. who donated Rs. 10,000/-, and a large plot of land with a bungalow to serve as residence to students. The original school was housed in what is at present the orthopedic ward. Later on three buildings were added through the efforts of the late Lt. Col. W. H. Burke, I. M. S. In 1928, the new science laboratories and the Pathological Department were opened by the then Minister of Education in the unavoidable absence of H. E. Sir Leslie Wilson, Governor of Bombay.

The School started on 1st November 1878 with 82 pupils on the rolls. It was formally opened by Sir Richard Temple on December 7th, of that year. At first the course of studies covered a period of 3 years, the first two being devoted to Chemistry, Materia Medica, Anatomy & Physiology and the last year to Hospital work. On passing the final examination, the successful candidates were given a diploma of *Hospital Assistant*, a term which was later changed to "Sub-Assistant Surgeon". Three classes of students were being admitted at the time, viz. the Native Military Pupils, the Stipendary Pupils, and the Civil Medical Pupils. Besides, there were paying students and Native State students. The Military pupils were destined for military work and the others were largely absorbed in the Subordinate Medical Service on the Civil side. In 1913, the College of Physicians & Surgeons of Bombay was founded on the abolition of the L. M. & S. degree of the Bombay University. The school was then affiliated to this College and a

diploma is now being issued by this body to successful candidates, after a series of three examinations, held in Bombay, the course prescribed now extending to cover a period of four years.

At present the school counts about 350 pupils on its rolls about 60 of these being women students. It has uptodate laboratories for science subjects and well organised anatomical, physiological and pathological departments, as well as a Museum for Anatomy and another for Pathology.

Meteorological Office.—The Headquarters Office of the India Meteorological Department is located on the Ganeshkhind Road at Bhamburda in a magnificent building with a conspicuous clock tower. The office, prior to its move to Poona, was in Simla. The present buildings in their grounds of over 10 acres were occupied in 1928.

Before describing the activities of this office, it is of some interest to take a brief review of its history. Prior to 1865 during the regime of the East India Company, there was little, of really systematic observation or scientific study of weather. Two disastrous cyclones which affected Calcutta and Masulipatam respectively in 1864, awakened public attention to the need of a system of cyclone warnings. About the same time, a Sanitary Commission was appointed to investigate climate in relation to disease. As a result of these, the Asiatic Society of Bengal, with the help of Mr. H. F. Blanford, drew up a report for placing before the Government a scheme for systematic meteorological work in the country. This led ultimately to the establishment of meteorological organisation in a number of provinces, in which Blanford became the first Meteorological Reporter to the Government of Bengal and in that capacity did very important work in connection with the studies of the weather of Bengal and north India in general. But the parochial system of dealing with a well-defined meteorological area like the Indian monsoon region was found to be unsatisfactory and led subsequently to the re-organisation of the various systems and their consolidation into a unified system in 1875, under Blanford as the first Meteorological Reporter to the Government of India. The Indian Daily Weather Report was first instituted in 1878, its need coming up prominently after the droughts and

famines of 1876 and 1877. The Daily Telegraphic Summary for the rapid dissemination of weather news was introduced in 1881. Ever since that time, the Department has been progressing steadily, the collection of data and their scientific study and interpretation of the climate and weather of India being carried the climate on under successive Directors-General, like Sir John Eliot, Sir Gilbert Walker and Mr. J. H. Field.

For a time the Headquarters Office of the department was in Calcutta with a branch or camp office in Simla, but ultimately the Simla Office assumed the supreme position and became the headquarters of the Department from about 1904. It was in Simla that Sir Gilbert Walker started the new lines of work on the statistical examination of meteorological data from the point of view of long-range forecasting of the seasonal rains etc. It was also there that Dr. Simpson did much of the now classical experimental work on the electricity of thunderstorms. Even the upper air work started by Mr. Field saw its beginning in excursions to the plains from Simla.

However by 1924, the Simla office with its cramped space was beginning to be found insufficient for the expansion of experimental work particularly concerning the exploration of the free atmosphere by sounding balloons. It was also unsuitable because it was not typical of the country under the influence of the monsoon. In the 50 years of its existence with headquarters at Simla, the headquarters office had no permanent official home and was being bundled through a series of temporary quarters. A proposal was therefore made in 1924 to make a move from Simla. Poona was the place selected, as it combined the advantage of being in the monsoon region, with a suitable climate and the availability of sufficient society for the staff and so on. Further, the chances of recovery of balloons and instruments sent up were expected to be good. The move was sanctioned in 1926: the buildings were rapidly erected, and the opening ceremony was performed in July 1928 by His Excellency Sir Leslie Wilson, the then Governor of Bombay.

The main functions of the office are the issue of warnings to ports and ships in the Arabian Sea regarding disturbed weather and cyclones, the maintenance of records of meteorological data, the publication of climatological statistics, the issue

of weather reports, like the Daily Weather Report, the daily telegraphic summary, as well as the seasonal rainfall forecasts, the issue of telegraphic heavy rainfall warnings, the issue of weather reports and warnings to aircraft, the study of the winds, temperature and moisture conditions in the upper air, and the conducting of meteorological researches in general. For the working of these functions, the office is divided into a number of sections like Weather Section, Marine Section, Library Section, Observatories Section, Instruments Section, General Section and Upper Air Section, each in charge of an officer responsible to the Director-General of Observatories. Very recently a new section of Agricultural Meteorology, for the co-ordination of the study of meteorology and agriculture in relation to each other has been added as a result of a temporary scheme sanctioned and financed by the Imperial Council of Agricultural Research. There are a number of branches or sub-offices of the Department, in addition to some 300 daily reporting and observing stations spread as far afield as Persia to Burma and about 30 pilot balloon stations. The principal sub-offices are at Agra, Calcutta, Karachi, Kodaikanal, and Bombay where there are special duties. For instance, Agra deals with upper air and Bombay with magnetic studies, Kodaikanal with Solar physics and Calcutta with storm warnings for the Bay of Bengal. The meteorological Office has its own workshop and laboratory and is equipped with a good library, containing standard works and journals on meteorology and allied sciences, numbering over 25,000 volumes.

Beam Wireless Station:—The Wireless Station situated 9 miles outside Poona is the transmitting station for the Beam Wireless Services to England by telephony and telegraphy and to Japan by telegraphy, the receiving station is at Dhond, approximately 50 miles east of Poona.

The station was erected in 1927 and a high speed telegraphic service was opened to England the corresponding receiving station being at Skegness, while Dhond receives signals transmitted from Grimsby.

The telegraph circuit to Japan was opened in November 1932 and the telephony service to England in May of 1933. The controlling office is in the Central Telegraph Office at

Bombay and the telegraph transmitters are keyed direct from there. Similarly the received signals at Dhond are relayed automatically to the Central Telegraph Office. This is done by means of a Carrier Current System consisting of Keying a number of channels of various high frequencies (of the order of 5 to 30 KC) on to the landline through suitable filters. Actually the Poona-Bombay trunks carry these channels simultaneously with the ordinary trunk telephone circuits. A new system of carrier current is being erected for the use of the Indian Radio & Cable Communications Co. which also incorporates a carrier current telephone system as well as the various channels in use for received and transmitted telegraph signals.

The wireless apparatus was designed throughout by Messrs. Marconi's Wireless Telegraph Co. and is known as the Marconi Franklin Beam System. This system replaced the original scheme of high power long wave transmission, its successful working being due to the following reasons. Firstly, it was found that high speed working on long waves, that is of the order of several thousand metres, was impracticable owing to the atmospheric interference found throughout the tropics and secondly, owing to the great attenuation of long wavelengths very high power would be necessary to obtain communication.

Short waves of the order of 15 to 30 metres however do not in general suffer from these defects, as atmospherics are negligible; and, if a suitable wavelength is used (depending on the amount of the signal path being in daylight or darkness and the time of the year) the attenuation is found to be very small.

It is therefore possible with short waves to obtain at the receiver a signal of good strength with a silent background using a relatively small power in the transmitter.

In the Beam system a directive aerial array is used concentrating the radiated power into a narrow pencil or beam. Similarly the receiving aerial is made directive, thus limiting unwanted signals and atmospheric disturbances, but of a maximum efficiency in the direction of the required transmission.

The aerial array consists of a number of vertical aerial wires suspended in one or more bays behind which are suspended vertical reflector wires. In short wave working it is necessary

that each wire be terminated with respect to transmitter or receiver electrically correctly; this is done by means of the Franklin Feeder system. The Feeders consist of two concentric copper tubes laid on supports near the ground and the aerials and feeders are interconnected by means of tuned terminating coils. This Feeder system enables all the aerial wires to act in phase with each other so that in the receiving array the available signal energy is conserved as efficiently as possible and in the transmitting, the maximum directive radiated power is produced.

By means of this feeder system and an aerial height of 200 feet it is possible to maintain a high speed circuit on the comparative low power of approximately 30 KW input to Transmitter.

The actual transmitter consists of a master oscillator driving through a chain of amplifying valves upto the last magnifiers which handle 5 KW each at 7000 Volts on the anodes.

To obtain a constant frequency the master oscillator consists of several stages of valves in Cascade. The first stage being an oscillator at a wavelength of about 3000 metres and each successive stage doubles or trebles this frequency, by picking out the required harmonic until the correct short wavelength is produced at the lowest powered magnified stage.

This frequency can be very accurately set by means of a vernier adjustment on the 1st stage of the Master Oscillator.

To obtain an even balance of power into the transmitter a valve absorber circuit is used so that all excess power when on 'space' is absorbed and dissipated as heat in the anode resistances of the absorber valves. The Transmitter is 100% modulated by means of a 1000 cycle oscillator as it was found that modulated carrier for telegraphy reduces 'fading' considerably.

Other features of the transmitter are:—The use of the Marconi Franklin Bridge Circuit for each power magnifier stage by which a perfect electrical balance is obtained. The lighting of the filaments of the magnifier stages by raw AC instead of DC as was hitherto used. And the anodes of the last magnifier and absorber valves are oil cooled while an air blast is used on the filament and grid seals. The telegraphy transmitters are capable of handling traffic continuously at 200 WPM, and over, provided radio conditions are suitable.

Considering the Telephony apparatus we find various modifications of the above scheme. Firstly the receiver at Dhond is of the latest Marconi design containing an automatic volume control device by which the effect of varying signal strength is reduced to a minimum. Also an accurate valve voltmeter provides a means of measuring speech levels. The selectivity is good consistent with an audio frequency band pass sufficient for broadcast reception.

The telephone transmitter differs from the telegraph ones in having a modulating circuit replacing the absorber, the set being of the high power choke modulator design. The frequency response is uniform over a range of 200 to 8000 cycles.

One of the difficulties of wireless telephony is the combining of the four wire circuit i. e., to transmitter and from receiver, for two wire land line working, and an elaborate piece of apparatus is designed for this purpose. This together with the secrecy apparatus, strength controlling and measuring devices is contained in the telephone terminal unit situated at the wireless station. It is here that the technical operator monitors both incoming and outgoing speech and maintains the necessary quality and speech levels.

By means of transmitting and receiving suppressors the received signal automatically closes the transmitting path and vice versa. Thus preventing inter-reaction of incoming and outgoing speech. The secrecy apparatus produces an inversion of the transmitted speech frequencies and re-inverts the incoming inverted received speech, so that reception by any unauthorised person is made impossible.

The power plant consists of three 125 KVA sets of Mirrlees Diesel Engines, driving 3 phase 400 V. alternators. The station being entirely self-supporting in this respect.

The above brief description will give an idea of the activities of the Transmitting Station of the I. R. & C. C. Co. which is probably the most elaborate and efficient wirless station in the East.

Experimental Broadcasting tSation :—In common with other Presidencies there is a movement abroad to employ wireless for the uplift of the Indian villagers and under the call-sign

VU 2 BY, the Western Indian Wireless Association is helping in this effort.

The object is of course purely experimental and has no connection with the official State Broadcasting service.

The transmitter is situated in the Connaught Institute and comprises a master-oscillator which feeds a Magnifier valve which in turn excites the aerial. The modulation is performed at the Main-magnifier and an 100 per cent value is available.

The experiments were first conducted on short waves of the order of 40 metres but experiments and experience has proved that for a service having as its motive village-uplift the service is too variable to permit success given by this type of wave.

A great deal of time has been expended in designing receivers and at the present time the field remaining to be covered is very large. It is worth noting that receivers employing the 'super-heterodyne' principle have not proved too successful for this type of reception. The Station operates on 175 metres and works three times a week at suitable hours.

The power employed is 100 Watts and due to a very effecient aerial system this gives the station a very useful range.

Permission is being sought for the experimental transmitter to be employed in experimental transmissions to schools, and so pave the way for a large educational activity using wireless as its source of instruction.

Photozinco Press.—The Government Photozincograhic Press was originally started in 1867 by the Survey and Settlement Commissioner purely for the reproduction of Survey and village maps. Since then, great developments have taken place and now this is perhaps the only establishment in India where so many branches of high class and artistic work are carried out all in one place, viz. drawing, compiling, revising and preparing original maps in different languages; designing and reproducing delicate colour charts including Medical Charts Diagrams, plans for all departments under the Government of Bombay and for the Military Department, school wall pictures in various colours; Anatomical pictures for use in schools published by the St. John Ambulance Association, Lahore;

Certificates of merit, Architectural drawings, School maps, and diagrams &c. for the scientific volumes published by the India Meteorolgical Department. Printing of Daily Weather Report for this Department is also done at this Press. In the Photo engraving branch, fine art reproductions of microscopical, medical, .geological, archaeological illustrations and colour plates to be incorporated in the report of the School of Art are reproduced by half tone tri-colour process, and offset process. Many a time the Press is required to reproduce in natural colours various articles of archaeological interest, such as ancient vases and works of pottery, specimens from Museums such as silk and embroidery work in silver and gold, carpets &c.; and these reproductions are required to be done from the natural objects themselves which are in most cases not only very clumsy for handling but require very careful and delicate attention. A great deal of work is done for the police and finger print department in order to assist them in tracing criminals and advice is given in cases of counterfeit notes, &c. Besides this a great deal of miscellaneous work, such as lantern slides, reproductions of old documents, reproduction of maps for Indian States, Marine charts, and other numerous subjects, is executed in this department. The work done is of a highly technical nature and requires men with a special training in the various processes.

Working side by side with this press is the Government Photo Registry where Documents, Sale deeds etc. are reproduced by photography. This is done by the film process. Pages of documents are photographed on the standard cinema film and from this, prints of standard size are made by the aid of a projecting apparatus. This process is very economical, fast and gives good results.

The following are some of the important processes in vogue in this Press:—

Lithography :—This is a planographic printing process, the printing surface being stone or zinc plates. The stone used is a special variety found solely in Solnhofen (Germany). The principle of this process is the natural repulsion between grease and water. The work to be reproduced is either drawn or photographically transferred on to the stone or plate and then

the stone or plate is chemically treated in order to make this transferred work permanent. The work done is in greasy ink.

Before printing, the surface is damped evenly and then a a roller charged with greasy ink is rolled to and fro sharply on the surface. The damp portions i. e. those on which there is no work do not accept the ink and thus a clear impression is obtained on paper when it is pressed over this surface.

Printing is done either on hand presses or machines. The latest development is offset printing. For this purpose a thin plate is used which is wound round one cylinder of the machine. On another cylinder is a rubber blanket which receives the impression from the plate and finally imparts it to the paper.

Half tone and three-colour block making. — This method is used for the production of engraved blocks for printing. These are prepared from negatives taken from originals (photographic prints, work drawings, water colour or oil paintings etc.) the half tones of which are reproduced by placing in front of the sensitive plate a glass screen bearing black lines crossed, so as to leave transparent squares. Light reflected from the whites of the the original picture forms a pencil of light through the transparent squares of the greatest intensity. From the shadows of the picture the opposite, is the result. The former will produce the greatest effect on the sensitive plate and will consequently give a large dot. In this way the various sizes of dots will be produced corresponding to the gradation of the tone. From this negative, a relief plate is produced by printing it on a zinc plate and etching away with nitric acid the transparent parts thus giving an image in relief.

Tri-colour Process. — This method is used for the reproduction of coloured drawings or natural objects in colour. It is a photographic process which selects the primary colours on a separate plate from a coloured object so that printing blocks can be made from the three negatives. These blocks are printed in yellow, red and blue inks respectively one impression exactly over the other, and the final result represents the coloured object in its natural hues. It is necessary to use colour filters while the three negatives are made in the camera. The filter is inserted between the object to be reproduced and the sensitive

plate. The filters used are Violet for the Yellow printing negative, Green for the Red, and Magenta for the Blue printing negative.

Deccan Paper Mills:—Poona has the distinction of being the only place in the Bombay Presidency where a cellulose industry other than cotton textiles, has found a home. The use of cotton, jute and similar fibrous plants had long been utilized in the making of fabrics, but the development of cellulose as a chemical industry came only in the last century, and at the present day, finds no mean place in the industries of the world. Cellulose is so widely spread on this planet that we meet it at every turn in different shapes and guises, put to different uses for the benefit of mankind. It is a curious dispensation of nature that cellulose, with its formula of $C_6 H_{10} 0_5$, should be co-extensive with another substance equally widely spread, and having the same empirical formula, viz., starch. Whether the researches of modern physics will throw any light on this empirical similarity is a question for *savants* to solve. For the present full advantage is taken of the physical and chemical characteristics of cellulose in harnessing it for public use, one of the most important of which has been its conversion into paper. The paper industry stands next in importance only to the food and textile industries, and if dissemination of knowledge and learning be taken as a criterion, it might rank as the first, like unto the brain which controls all the faculties.

The starting of a paper industry in Poona nearly half a century ago by the well-known Pudumjee family of Poona is a trite fact known to all who know anything of Poona and its environs. It was the suitability of the climate and the existence of other facilities that led to its establishment at Mundhwa, about five miles from Poona, just as an ammunition factory, where also cellulose forms an important base, was located by Government at Kirkee. Thus it was that there came into being in 1885 the Deccan Paper Mills Co., Ltd., for the manufacture of paper. Lord Ripon, the then Viceroy of India, gave it its first impetus by the inauguration of a policy of using indigenous articles and products in Government Departments. The two Pudumjee brothers, viz., the late Sirdar Khan Bahadur Dorabjee Pudumjee and the late Sirdar Nowrojee Pudumjee, C. I. E., started the mill as a company registered under the

Indian Companies Act in 1885, with a capital of five lacs. It is situated at the village of Mundhwa, adjoining the Hadapsar Railway Station of the G. I. P. Railway. The extensive grounds of the factory occupy about eighteen acres, and the Mula–Mutha canal snpplies it with a plentiful supply of water, so necessary for a paper industry. Considerations of transport facilities, and abundant supply of labour, proximity to the centres of raw materials and an easy access to the market for its output, led to the selection of this site. In 1925 the development of the industry necessitated an increase of capital, which was then raised to nine lacs and a quarter, and with the Mundhwa factory was associated a factory in Bombay, started in 1913 as a private proprietary concern.

The grounds at Mundhwa have been laid out in different departments requisite for a paper industry. There is the main building, which houses two paper machines side by side with a central passage between. The engine and boiler houses are suitably located next to the main structure, the present motive power being coal-produced steam. Four boilers of the Lancashire type feed the steam engine of 500 H. P., fitted with Green's economisers, together with other adjuncts to serve the needs of economy. Changes in the motive power are in contemplation to satisfy the constant urge for economy, to be enabled to face the ever increasing competition in the industry.

All up-to-date machinery and fitments for handling different kinds of raw materials from the raw state to the finished product find place at the factory. There is a rag department with huge stacks of rags, where the rags, after undergoing willowing and dusting, are taken in hand by the rag choppers that reduce these materials to a proper size. The chopped rags then go to the Rotary Kiers or rag boilers, where they are digested by steam under pressure. The digested rags next go to the rag-beaters or Hollanders, where they are treated with the necessary chemicals for the preparation of which the Company has a small plant at the factory. Old paper utilized in the manufacture is treated in a kneader or waste-paper pulping machine. The finished and bleached pulp is delivered to the huge wire belt of the paper machine, where it assumes the form of a wet sheet, which is later dried on the steam-heated cylinders of the paper machine,

and delivered as fully made paper. There is a calendering end of the machine, which sends forth paper in the shape of huge reels. In the cutting department these reels are cut into the desired pieces of sheets and sorted, and packed into reams and packages in the packing department.

The Company manufactures all the principal trade classifications of paper, the full list whereof extends to over thirty varieties, dependent upon demand, the supply of raw materials, and various other circumstances incidental to manufacture.

Residential blocks for those of the employees who choose to reside on the premises are provided at Mundhwa, and there is a qualified medical man to look after the bodily welfare of the staff and hands. Infant welfare is represented by a creche where the children of the female workers are looked after during working hours, and general welfare work is gradually receiving attention.

The registered office of the Company is at 815-16, Bhawani Peth, Poona, with a branch office at the Ballard Estate, Bombay.

Padegoan Sugarcane Research Station.—The scheme, comprising of Research Laboratories, Offices and Research Farm of 105 Acres, is situated near Nira Railway Station of M. & S. M. Railway on the old Poona Satara Road at mile 43 from Poona. The Laboratories are on the main road, whilst the Farm is about 3 miles from the main road on the Nira Right Bank Canal, in Phaltan State.

The scheme is mainly subsidised by the Imperial Council of Agricultural Research, and the work has been started only from June 1932. The principal object of this research scheme is to ascertain the most economical method of producing a ton of cane, over a series of years, under the canal conditions of the Bombay Deccan which may be regarded as broadly typical of Peninsular India. The problems involved fall into 3 main categories namely-(1) Soil problems, (2) Plant problems, (3) Magagement problems.

The research programme has accordingly been organised under the three sections.

The Farm which comprises of 105 acres and which has been developed only recently has under sugarcane about 22 acres, under different interesting experiments in all sections. With

cane other rotational crops such as Cotton, Nilawa (Jowar), Ground-Nut, etc. are also grown.

Lord Reay Industrial Museum:—A Museum containing valuable exhibits in the shape of antiquities and specimens of ancient art and modern industry is an institution of great educative value, and the revival of the Lord Reay Industrial Museum, at Poona would be appreciated by persons interested in the industrial advancement of India. The idea of a Museum was started in Poona as early as 1875, and a Museum was brought into existence with the help of public subscriptions. This Museum consisted of 1650 articles, chiefly specimens of geology, chemistry and some manufactures of indigenous art. From the records available it is found, that the City Municipality used to contribute Rs. 200/- per year towards its maintenance, but only after a few years the Museum was closed. References to available records go to show that annual exhibitions were organized in Poona since the year 1875 with varying objects and aims in view. One of the exhibitions was designed for the show of manufactures of native arts. On another occasion it displayed various raw products of the forests, and so on. Several attempts in this direction were made persistently between the years 1875 and 1888. But it appears that no attempt for an elaborate and comprehensive scheme was made upto the year 1888. In that year a scheme for an exhibition on a large scale was put forth by the active co-operation and initiative of men like the late Justice M. G. Ranade, Namjoshi, Dhakji Kashinathji and G. V. Joshi, which received the most sympathetic consideration of the then Governor, Lord Reay. This exhibition received all possible help at the hands of the Government of Bombay and through its recommendation from all Provincial Governments of India. The exhibition was a great success and in the year 1889-90 under the auspices of the Industrial Association of Western India the Poona public collected Rs. 17,000 to raise a memorial to Lord Reay and gave it the form of this Industrial Museum, called after him.

The Museum was in existence upto 1896 when Mr. M. B. Namjoshi the active organizer of the Exhibition and Museum died. For want of a capable successor and owing to the disastrous effects of plague and famine, the Industrial Association

of Western India which did this pioneering work, handed over the funds and the exhibits to the Poona City Municipality, and the Association got itself dissolved. The City Municipality has been the custodian of the funds and exhibits since then. The Poona City Municipality has now in its hands an accumulated sum of Rs. 39,000 ear-marked for the Reay Museum. For some time the President and Vice-President of the Poona City Municipality and a nominee of Government used to be the trustees of the Museum and its funds.

But later on the Municipality could not undertake the scheme of the revival of the Museum with the small funds it had, until 1929 when the purchase of the Peshwa Palace of Vishrambag enabled it to take up the project.

The fact that the Local Bodies have now been empowered under the new Municipal Boroughs Act to maintain a Museum out of the Municipal Funds, has enabled the Poona City Municipality to revive and reorganize the Lord Reay Industrial Museum and put it on a stable basis by giving a grant-in-aid of Rs. 5,000 per annum.

With the establishment of a Museum in a building almost its own and looked after by a permanent Committee, a centre has now been created for the future economic and industrial activities of the Deccan. It will be easy for merchants, manufacturers and scientists to hold their conferences at any time of the year. Just as the aims and objects of libraries have undergone enormous change in their conduct and the policies which govern them, the ideas which are associated with a modern museum have a wide, almost international character and scope.

The aims and objects as at present conceived by the management are not only the establishment of a show room where finished products from different provinces would be exhibited, but is is also proposed to divide the Museum into several sections, prominent amongst them being the Information-Branch with its library and a reading room, where books, pamphlets, newspapers of commercial, manufacturing, scientific and economic interest will be kept. It will further consist of elaborate exhibits illustrating the history, processes, appliances of particular industries and their relative position with reference to other countries.

INDIA METEOROLOGICAL DEPARTMENT.

Brief list of publications issued by the Department.

(A complete list may be obtained on application to the Director-General of Observatories, Meteorological Office, Poona 5.)

PUBLICATIONS OF RESEARCHES :

Memoirs of the I. M. D. (25 volumes) Examples :—

Vol. XXV—Part I. "Sky Illumination at Sunrise and Sunset" by K R. Ramanathan.

Part IX. "Evaporation and its Measurement (First Paper)" by S. K. Banerji and H. M. Wadia.

Part X. "Solar Radiation Measurements at Poona in 1931" By S. S. Kohli.

Vol. XXVI—Part I. "Registration of Earth Currents" By S. K. Banerji.

Scientific Notes (5 volumes, 51 numbers). Examples :-

Vol. III No. 20—"Correlation between Rainfall in N. W. India and height of Indus River at Sukkur" By Rao Saheb M. V. Unakar.

No. 30— 'The structure of the Sea Breeze at Poona" by K. R. Ramanathan.

Vol. IV No. 37—"The Seasonal Forecasting Formulae used in the India Meteorological Department" by S. R. Savur.

MEMOIRS OF THE KODAIKANAL OBSERVATORY, Vol. I.

Part I, "The spectrum of sunspots" by J. Evershed

Part II "Results of prominence observations" by J. Evershed and Mary A. Evershed.

Kodaikanal Observatory Bulletins : (Prominence observations and research papers)—(4 volumes, 100 numbers),

Colaba Magnetic Data : 1846-1905, Two parts, by N. A. Moos.

MISCELLANEOUS PUBLICATIONS :

"Storm tracks in the Bay of Bengal—A series of monthly charts for the period of 1891-1923" (1926) by C. W. B. Normand.

"Storm tracks in the Arabian Sea" (1926), by C. W. B. Normand.

"Meteorology of the Persian Gulf and Mekran" (1931), by B. N. Banerji.

"Winds, Weather and Currents on the coasts of India and the Laws of Storms" (1931), Departmental.

PERIODICAL PUBLICATIONS :

Daily Weather Reports (Published at Poona and Calcutta).

Weekly Weather Report.

Monthly Weather Report.

India Weather Review and Annual Summary.

Magnetic, meteorological and seismological observations made at the Government Observatory, Bombay. (1898-1929), Annual volumes from 1921.

Daily and Monthly Rainfall of India.

Upper Air Data, 12 monthly parts and 2 annual parts.

MANUFACTURE OF

INDIGENOUS BIOLOGICAL PRODUCTS IN INDIA.

(BENGAL IMMUNITY Co. Ltd.)

For the supply of useful therapeutic agents we had to depend entirely on foreign manufacturers till of late. The year 1919 will find a place in the annals of the medicinal industry in India as in that year a beginning was made in India in the direction of the manufacture of Sera, Vaccines and Organotherapeutic products by the starting of the Bengal Immunity Company under a Board of Directors and Working Committee consisting of prominent and renowned members of the medical profession.

In the preparation of indigenous biological products, this pioneer concern has successfully maintained and by merit strengthened its reputation in the estimation of the general public. They enjoy confidence and support of many Medical College Hospitals, State Dispensaries throughout India, Burma, Singapur, Malay Peninsula, Mesopotamia, East Africa etc., The demand for its products from all quarters has increased quite remarkably.

Besides, the Biological line, the Company has a pretty long list of other products, viz, Injectable Chemical Solutions, Organtherapeutic products, Hæmogen combinations, Malt preparations, colloid products, and other specialities etc.,

The confidence and support that this Company has steadily gained from the medical profession, are conclusive proof of the genuineness and efficacy of the products. The products have been tested from time to time in several of the well established laboratories and they have received recognition from the highest authorities in the line.

The other day Dr. G. V. Deshmukh, M. D. (London), F. R. C. S. (England), visited the Bengal Immunity Laboratory with many other delegates and members of the "All-India Medical Conference" and was very much impressed with up-to-date methods of manufacturing Sera, Vaccines etc., the following being his remark about the working of the Laboratory:—

"Through the courtesy of the Directors and medical gentlemen of this Institute I was privileged to go round the Institute this morning. It is rare that I have ever spent such a useful and instructive morning. I was shown all the scientific stages of preparing vaccines and Sera and I must say that the methods are very scientific and accurate. They have very healthy snd beautiful surroundings and what is more, they keep a biological farm of their own where they have their own horses and animals. I wish them every success. They are doing a great scientific and national work."

This concern has proved quite clearly that success can be achieved in the preparation of Sera, Vaccines and Organo-therapeutic products in this country and under physical conditions similar to those in which the diseases for which they are to be utilised, flourish. It has done a really useful work by providing fresh, reliable and safe products to our country. The Laboratory has made arrangements for further facilities for research along these and other lines.

Peshwas' Daftar: — The Peshwas' Daftar at Poona is a vast collection of old state papers, both historical and administrative, owned by Government. These papers were first reserved by Mr. Maclead under instructions from Governor Elphinstone ·from the Peshwas' archives when the Maratha power was conquered by the British in 1818. The papers were located at first in the Wada of Nana Phadnis now occupied by the Poona New English School and were minutely examined and arranged by the Inam Commission between the years 1845 and 1863. They thus came to be entrusted to the Alienation office and were removed in 1890 to its present strong stone building opposite the Council Hall. All the papers have been well classified and preserved and scrupulously guarded against fire or other dangers. A descriptive guide to this historic collection has now been prepared and published by Government and is issued from the Government Central Press, Bombay at a price of 11 annas per copy. This valuable booklet contains a beautifully coloured chart marking the various divisions of the Daftar with the number of bundles belonging to each and the periods to which the papers pertain. It can be seen from this guide that the total bundles in the collection number about 35,000, of which roughly 27,000 are Marathi, written in old Modi characters and the rest are English in well bound files with quite an insignificant number in Gujarati and Persian.

At the instance of the Historical Records Commission, the Government of Bombay started in 1929 a thorough investigation of the Daftar by a staff of Readers working under the expert guidance of Mr. G. S. Sardesai, a well known student of Maratha History. These workers selected a large number of important historical papers and arranged them in a series, for publication of 45 different parts, of which some thirty parts containing over 5000 pages have been aleady published with suitable English notes and explanations. It is hoped that the remaining fifteen selections will also be out in quick succession. The total cost of the undertaking has been about rupees forty thousand. Maratha·History will now be immensely enriched by means of these profuse historical materials.

The English files also are by no means less interesting or valu able to students of Indian History, as they belong to a

period of over thirty years between 1785 and 1818, when the British had their regular succession of Residents at the Peshwa's Court. These Residency files have been examined and arranged by Sir Jadunath Sarkar of Bengal who has undertaken to select and print a few volumes out of them. The work is at present progressing. It will thus be noticed that the long standing question of having the historical contents of the Peshwa's Daftar properly explored, has been finally set at rest and provision is now made for students of the subject getting easy access to the records for inspecting them on the spot, where a Reading Room has been arranged and some of the most important bundles are set apart.

Bharat Itihas Sanshodhak Mandal.— This association of workers in the field of Indian historical research was established in 1910 by the late Mr. V. K. Rajwade and Sardar K. C. Mehendale with the object of collecting material for history research, to promote scientific study of history and to edit and publish books and manuscripts which would accelerate these objectives. The Mandal edits a quarterly and has so far published about 50 volumes. Although there are no constitutional restrictions on its field of activities owing to the special facilities available to its members, they have concentrated their efforts more on the investigation of the history of Maharashtra in the last three hundred years. It has an excellent collection of original letters, manuscripts, copper-plates, coins, old pictures, arms etc. and offer exceptional opportunities to a student of history.

The late Mr. V. K. Rajwade travelled in all parts of the Deccan with the object of finding if any original letters and documents could be secured in the many famities which had close association with Shivaji and his successors and his efforts were richly rewarded. During his life he edited and published a large part of his collection and also inspired a number of young men with zeal for that kind of work. These workers as also others who were interested in the work or sympathised with it formed themselves into the above association. It has a tolerably good building of its own where the members meet once a fortinght and submit for discussion any new material they may have discovered. It has 767 members.

Among its important publications may be mentioned the one giving for every day, month and year between A. D. 1630 and A.D. 1830 the corresponding days, months and year according to Shake, Arabi, Hijari, Fasli and Rajyabhisheka Eras which commonly appear in the documents and letters of this period. Persian correspondence between the English and the Peshwa Governments, and the Adilshahi Firmans are in press. It has so for been able to collect above Rs. 35000 by way of subscription from the different parts of Maharashtra and about Rs. 15000 by loan. A recent benefaction to the Mandal which deserves to be noted is by Dr. Justin E. Abbot an American Missionary who lived a large part of his life is this part of the country and who in his will left a sum of $ 300000 for this Mandal. It is expected that about a third of this sum will be realised.

The Bhandarkar Oriental Research Institute —arose out of the happy inspiration which the late Dr. P. D. Gune and other Sanskrit scholars in this city had in 1915, of perpetuating the memory of Dr. R. G. Bhandarkar by establishing an institute for research particularly in Sanskrit and Jain literature. It was liberally helped by the Tata brothers and the Government of Bombay agreed to hand over its collection of Manuscripts at the Deccan College, to the Institute together with the annual grant of Rs. 3000 for its maintenance. It also handed over to the institute the Bombay Sanskrit Series and the grant of Rs. 12000 annually paid for it. The institute was formally opened on 6th July 1917, by Lord Willingdon, the then Governor of Bombay. It has a splendid building worth about Rs. 125,000 in an open space at the foot of a hill, at a distance of about four minutes walk from the Servants of India Society's home. The Manuscript Department of this Institute has about 20000 manuscripts collected by Professors Bulter, Kielhorn and Bhandarkar during the last sixty years and is under the supervision of Prof. S. K. Belvalkar. The Iranian and Semitic Department is controlled by Prof. Shaikh Surfrar and has about 200 manuscripts and an equal number of publications. The Publication Department has kept on the editing and publication of the old Sanskrit series and has been paying special attention to the publication of Jain literature which has become possible by a munificent gift from the Jain public.

The Institute publishes a journal which is edited by Prof. Gajendragadkar of Elphinstone College, Bombay, and has also undertaken the work of preparing and publishing a new edition of Mahabharata under the general supervision of Dr. V. S Sukhtankar.

From 1927 the Institute has also made provision for Post-graduate study in Sanskrit, Pali, Ardhamagadhi and Ancient Indian culture with a view to preparing students for the M. A. of the Bombay University. Very recently ; thanks to the munificence of H. E. H. the Nizam of Hyderabad, the Institute has added a substantial guest house to its buildings.

Anandashram—The late Mr. Mahadeo Chimnaji Apte, a well known pleader of the Bombay High Court devoted a large part of his property for founding this unique institution which secures and publishes old Sanskrit books. It has now in its possession about 8000 Sanskrit manuscripts and has so far published over a hundred Sanskrit books. It also provides lodging and boarding for a few students and scholar-Sanyasis. Scholars are permitted to use the Manuscripts in the library of the Anandashram. It has its own building in the heart of the city.

Deccan Vernacular Translation Society :—was established in 1894 with the object of encouraging the translations of well known English works. It awards prizes to some of the Marathi books sent to it for approval. The amounts thus paid are small, nor is it possible to pay more, as its financial condition is not very prosperous. But it has done a very useful service to the cause of Marathi literature in the 40 years of its life.

Servants of India Society —The Servants of India Society was founded by the late Mr. G. K. Gokhale in 1905 with the main object of providing trained and devoted whole-time workers to the country. The Society pays what may be called a subsistence wage to its members, who thereupon pledge themselves to dedicate themselves to the service of the public through the Society, doing such work as it may call upon them to do. The pledge which the members give extends to their whole physical life-time, and theirs is consequently a life-membership in the literal sense of the term. The work which the Society assigns to members is of all kinds: political, social, educational, etc. Special training is given to members for five years after

their admission, in subjects which in the Society's view the individual members may have a special aptitude for, and opportunities are then provided for the members to carry on for the rest of their lives the work which they have qualified themselves to do. One important feature of the Society's activities is that the institution, while keeping its doors open to all castes and creeds, is itself above them all, recognising no distinctions in this respect. Its members therefore are administered a vow to look upon themselves as Indians and not as belonging to any particular section. As a necessary consequence of this, the members can take up only secular or non-religious and non-sectarian work, the tie which binds them together and binds them for life being, not a common faith as in many other public bodies, but a common patriotism and common ideals in regard to social and political reform. Another feature of the Society's organisation is that most members carry on the activities to which they are called neither on their individual account nor on account of the Society as a whole, but as parts of and in the name of other institutions specially formed for the purpose. Though its membership is therefore very severely restricted—at present it is only about 35 all told—it is enabled with the help of other institutions with which it co-operates to turn out a fairly large quantity of work though the credit for it does not belong to it exclusively. Indeed, each of its members forms as it were a centre of a paticular activity and often supplies the driving power to the institution formed *ad hoc* for carrying it on. The Bhil Seva Mandal may serve as an instance in point. It is a Mission to the Bhils, which owed its origin to a member of the Society and still owes a great part of the work necessary to keep it alive, to him. But the Mandal has its own life-members and volunteer workers, who number at least half of the members on the Society's roll. The Social Service League is another such institution, the inauguration and the maintenance of whose activities are due mainly to the service rendered to it by a member of the Society. Its activities are manifold and workers are numerous. The Society takes little part in its day-to-day administration but contributes what may not unfairly be called direction and guidance. In the two activities mentioned above as well in

some others like trade union organisation, scouting, co-operation, rural uplift work, etc., the Society has the honour of doing more or less pioneer work, and in fact its avowed object is to take up new activities, conduct them in such a way as to pass them to other agencies and then to retire from the particular field, chosing another if possible which still remains virgin. In politics its affiliations are with the liberal party, though it retains its freedom to act independently when occasion requires—a freedom which it has exercised in practice. It pins its faith to dominion status as the goal and constitutional activities as the means, understanding both in a broad sense.

Gokhale Institute of Politics and Economics.–The Gokhale Institute of Politics and Economics was founded in 1930 as the result of a donation of nearly one lakh and 20 thousand rupees made for the purpose by Rao Bahadur R. R. Kale, M.L.C. of Satara to the Servants of India Society. The Institute is located in the Servants of India Society's Home and its foundation was made possible by the splendid collection of books, reports etc. built up in the Servants of India Society's library since the time of the late Mr. Gokhale. The main purpose of the Institute is to conduct investigations into economic and political problems of India the results of which may provide the besis for future constructive work. The Institute also participates in the university postgraduate work in economics and politics in Poona and has few research students on its rolls. At present only the economics branch of the Institute has been opened.

Ranade Industrial and Economic Institute: — established in 1908 as a memorial to the late Mr. Justice Ranade. It is affiliated as a post-graduate institution to the Bombay University and possesses a chemical laboratory where post-graduate students conduct research work on various problems of pure and applied Chemistry. Industrial problems are also studied in the laboratory which maintains an information bureau for the use of the public.

Deccan Sabha:—is a political organisation started in 1896 with the object of carrying on propaganda in political matters, by constitutional methods. The late Mr. Gokhale was the first secretary of the Sabha and a number of well known names appear among its members. Originally associated with the

Indian National Congress, it severed its connexion with that body in 1918 and got affiliated to the All-India Liberal Federation which was formed in that year. The Sabha has now a spacious hall built as a memorial to the late Mr. Gokhale, and the Rt. Honble. Srinivas Sastri is its President.

Sarvajanik Sabha:—was established in 1870, with a view to ventilate public opinion in an organised manner and was then largely supported by all sections of the public. In 1884 it purchased a building of its own. The Sabha soon came into prominence on account of its skilful handling of the public opinion on the occasion of the Famine of 1877–78, the local Self-Government Bill of Lord Ripon and the Crawford case. For about thirty years the Sabha continued to be a powerful exponent of public opinion, but in 1896 an important section formed a separate Association, the Deccan Sabha, and the Sarvajanik Sabha fell somewhat into the background.

Agri-Horticultural Society of Western India : — This Society was established in 1830 in Bombay. It developed the Victoria Gardens at Bombay under the guidance of its Honorary Secretary Dr. (afterwards Sir George) Birdwood, over an area of some acres of ugly, swampy waste land handed over by Government. The Society later on made Poona its headquarters in 1881. It has now charge of the Empress and Bund Gardens, described below.

Empress Botanical Gardens:—These were formerly known as the Soldiers' Gardens. They were in charge of the Military authorities, but as they could not be kept up by them, they were taken over by Government, and in 1892 handed over to the Agri–Horticultural Society of Western India, Government guaranteeing a deficit upto Rs. 3,000 annually. Here good vegetable and flower seeds, cut–flowers of all kinds and plants in pots are sold at very moderate rates to all applicants. The Superintendent and his assistants despatch Wedding and Presentation Bouquets, Funeral and Service Wreaths and Crosses etc., at short notice to outstations also. The gardens are situated east of the Race Course on the Prince of Wales Drive, a most pleasant and in fact the drive par excellence of Poona. It is about two miles from the Post Office by the car-

riage road, although from the Grand Stand it is but ten minutes' walk across the parade ground. The gardens have been very much improved of late; flowers and plants of rare and beautiful kinds may be seen here. The Poona Flower Show is held here as the beautiful gardens provide excellent room and scope for display of the floral function. All information as to supplying plants, fruits, vegetables, flowers etc., may be obtained on application to the Superintendent at the office in the Gardens.

Experiments of all kinds are made, advisory work is carried out, and students not only from the local Colleges and Institutions, but from out-stations also visit the Gardens for Botanical study, practical work and commercial knowledge. The aid thus given has been from time to time acknowledged by the students and their professors.

Correspondence is carried on with the Agri-Horticultural Society of London; Royal Botanic Gardens of Kew and Edinburgh; Department of Agriculture, United States of America, Washington; Bermuda, Ceylon, Mauritius, Batavia, Cairo, California, El Dueim, Ottawa, Potchefstroom, Sydney, Suva, Honolulu, Leningrad, Kuala Lampur, Yokohama, Khartum etc. etc., with whom exchanges of seeds, bulbs and plant materials are regularly maintained.

Seeds, seedlings, cuttings, flowers are supplied free to charitable institutions, churches, hospitals, etc.

Bund Gardens:–These gardens were thrown open to the public in 1860. As they could not be worked satisfactorily by the Public Works Department, they were handed over to the Agri-Horticultural Society of Western India in 1898. The gardens are well-known, being situated on one of the most frequented and popular spots in the whole of Poona, on the south bank of the Mutha-Mula river, which is spanned close to the gardens by the Fitzgerald Bridge, over which runs the road leading to Kirkee via Deccan College on the left Bank and another road which branches off to the right to Yeravda and to Ahmednagar. The gardens were designed and constructed by the late Colonel Sellen, R. E., on an unsightly piece of waste ground. The grounds are tastefully laid out in terraces reaching to the river side and contain a fountain, fernery and bandstand. The gardens are beautifully planted

and well-kept. Travellers from the Riviera and the Bay of Naples have been reminded in this spot of sights and scenes they have dwelt on long ago, and dream of again. Connecting the gardens with the opposite bank of the river is the Sir Jamsetji Bund, constructed originally to dam up and conserve water for drinking and household purposes, but since the construction of the Khadakwasla water works, no longer needed to fulfil the benevolent purpose for which it was erected upwards of 60 years ago. In the hot weather one may walk across the bund from one bank to the other, but during the rains the swollen river lightly disdains this massive obstruction, and surging tempestuously over it thunders down into the hollows beneath, roaring and growling so as to be heard for a good distance. The sight is strikingly attractive, particularly on a moonlight night when everything else in and around the gardens is wrapped in silence, and only the rapid restless river glides with silvery sweep smoothly onwards, till it leaps headlong over the Bund. as a raging torrent.

Shivaji Preparatory Military School:— established in 1932 as an All-India Memorial to Shivaji the founder of the Maratha Empire. The School aims at preparing students for the admission examinations of the Indian Military Academy and other military courses in England. It possesses at Bhamburda near Lloyd Bridge an excellent School building, extensive playground and quarters for students and staff. An imposing bronze equestrian statue of Shivaji prepared by Karmarkar is situated to the southwest of the School building and forms part of the Memorial Scheme.

SPORT

Poona has always been known for the keen interest that its citizens have taken in sport and for the large number of sporting institutions that it possesses. Circumstances have been principally responsible for this healthy development. The climate of Poona is equable and bracing. It induces among the population a natural desire for exercise of all kinds. For over two centuries this city has been the political centre of the Deccan. Under the Mahratta government the State deliberately fostered such institutions as akhadas (physcial culture centres) and the officers of the state took a personal interest in

the periodical sports meetings. For the youth of all classes of society, joining a suitable *akhada* during the years of growth was considered a necessity. Even today almost every street in the city has its own akhada or talimkhana where large numbers of boys learn such games or sports as Lathi, Malkhamb, Wrestling and Lejim. Owing to a change in social ideas and the greater attraction of the so called western sports the membership of these akhadas is now confined in a large measure to the educationally backward classes. Almost every week in the fair season has its own fixture of a well advertised wrestling match between representative wrestlers of two akhadas. Some times an outsider from other parts of the Deccan meets a local candidate for championship. The daily routine of the akhadas and their periodical wrestling meetings are events of great importance in the sporting activities of this city. In addition to this there is a great deal of activity in the modern and western games and sports under the auspices of various clubs and Gymkhanas, the principal among which are listed below.

GYMKHANAS AND CLUBS

Club of Western India:—for Europeans; is situated in Camp.

The Poona Club:—open both to European and Indian gentlemen is situated opposite the Council Hall and has an extensive cricket ground as also a Golf course and a polo ground.

Royal Connaught Boat Club:—is situated in Kirkee and has the object of encouraging rowing and sailing. It posseses a large number of boats and the season extends from October to end of May.

The Rangers Golf Club:—at Wanowrie; established in 1897.

Parsi Gymkhana:—is situated in Camp and possesses a good cricket field.

Islam Gymkhana:—started recently is also situated in Camp.

Deccan Gymkhana:—is situated near Lakdi Bridge and is a cosmopolitan sporting institution with cricket, tennis, hockey, football, swimming, Indian gymnasium and billiards departments. It has done great service in encouraging the love of outdoor sport by holding various tournaments and awarding trophies. It has developed a large colony of residential bungalows.

The P. Y. C. Hindu Gymkhana:—is situated to the north-west of the Deccan Gymkhana and maintains departments for cricket, tennis, hockey, football and billiards. It has done great service to the Deccan in raising the standard of cricket and other western games.

Maharashtra Vyayam Mandal:—is an institution for the encouragement of Indian Games and a general love for outdoor sports. It has a very well-equipped · gymnasium and conducts classes for both men and women teachers. Instructors trained by the Mandal are now working in various centres and receiving good encouragement.

The Poona Hunt:—the oldest Tent Club in India having been started in 1815. The Hunt meets most week ends from February to the beginning of the rains.

Western India Turf Club:—Racing season in Poona is from July to October.

MISCELLANEOUS INSTITUTIONS

Hospitals:—The principal Hospitals are (1) The Sassoon Hospitals, (on the way from Railway Station to Camp), (2) King Edward Memorial Hospital for women and children, (Rasta's Peth), (3) American Mission Hospital for women and children, (Mangalwar Peth), Infectious Diseases Hospital (near Railway Station), (5) Connaught Military Hospital, (6) Central Hospital for Mental Diseases, (Yeravda).

United Service Library:—Camp.

Poona City Library:—Budhwar Peth.

Willingdon Soldier's Club:—Lothian road, Camp.

Connaught Institute:—Y. M. C. A.

Boy Scout's Local Association:—(about 20 troops and packs.)

Girl Guides Association:—Poona division (about 30 companies and flocks .)

Royal Society for Prevention of Cruelty to Animals:—Poona branch.

Western India Automobile Association

MUNICIPAL NOTES.

Drainage:—Previous to 1910, the sullage from the City was disposed of by underground masonry drains, constructed by the Peshwas, discharging into the Mutha river. A partial scheme providing for pumping the sewage to septic tanks at Hadapsar, was carried out between 1910 and 1916 to a total cost of Rs. 14,23,893. The effluent gravitated to the area commanded by the Mutha Right Bank Canal and was utilised for intensive cultivation. But the pumping plant and disposal works proved inadequate to cope with the quantity of sewage and sullage reaching the pumping station near Daruwala Bridge; and a large quantity of sewage had to be allowed to overflow into the river. A second scheme designed to deal with 5 millions gallons of sewage per day from the city and to *interrupt* an additional quantity of 2½ million gallons from the cantonment and other local authorities, has been carried out from 1925 to 1933 at a total cost of Rs. 35 lakhs.

The whole internal sewage of the city passes through a main outfall sewer passing along the right bank of the Mutha river through the Suburban and Railway areas to an outfall pumping station near the junction of the Bahiroba Nala with the Mutha river. From this pumping station the dry weather flow of sewage is pumped to distributaries 3 and 5 of the Mutha Right Bank Canal for the irrigation, after •dilution with canal water of the areas amounting in all to about 4350 acres commanded by those distributaries. The city is now provided with a complete water carriage system of night soil and all kinds of sewage including night soil are carried by stoneware pipe drains from 6 to 18 inches in diameter, to the gravitation sewer and thence to the pumping station. Two pumping stations are provided for lifting the sewage from the low-lying area of the city and Bhamburda into the gravitation sewer. Loans of about 22 lakhs have been obtained from the public and from Govt. for financing these schemes and are being repaid by annual instalments of over a lac and a quarter. Government has contributed about half the cost of the two schemes, amounting in all to about Rs. 21 lacs.

Water Supply :—Upto 1875, Poona City was provided with a good water supply from the Katraj Tank about 6 miles to the

south of the city, constructed by the Peshwas in 1760. This source provided about 10 lacs of gallons daily to the city. There were also three private supplies belonging to different Sardars in the City providing about 1 lac gallons each. These latter have recently fallen out of use. In 1875, water was laid in the city from the Mutha Right Bank Canal constructed by Government. The present supply from the canal amounts to about 80 lacs of gallons, with a supplementary supply from the Katraj Tank amounting to about 8 lacs of gallons per day. The city has to pay for canal water at Rs. 2/8/-per 62,500 gallons upto 60 lacs gallons per day and at Rs. 4 above that quantity. The canal water is first taken into a bye-pass channel and there treated with chlorine powder all through the year. Alum is also added during the rains to purify muddy water. Samples of canal and pipe water are sent daily to the Public Health Laboratory, where the daily dose of chlorine and alum is prescribed after analysis of the samples. About 20 lacs of gallons are pumped daily to high reservoirs, from where water is distributed to the high level areas of the city. Recently the distribution mains throughout the city have been enlarged at a cost of 4 lacs of rupees and pressure in housepipes has been increased, so that water can rise to upper stories of buildings for a great part of the day. The water supply in this city lasts all day and night, which cannot be said of any other large town in this presidency. The chlorination of the water supply of the city was started in 1918 and cholera, enteric fever, dysentery and other diseases due to impure water have become very rare since then. The city had formerly a very large number of wells providing good drinking water throughout the year. But they have fallen into disuse since the supply of pipe water has become abundant and the Municipality has compelled house-owners to cover up disused wells with a view to prevent nuisance from mosquitoes. The daily consumption of water from municipal pipes is 52 gallons per head, which is much lower than that of Poona Cantonment and some other cities of India and Europe. The annual cost of canal water, to be paid to Government exceeds Rs. 1,25,000 at present and schemes for obtaining water from sources other than the Government canal are under consideration of a special Committee of experts. Katraj water was condemned by Government in 1919 through

some misunderstanding; but efforts are now being made to utilise this large supply by removal of its defects, as it costs nothing to the Municipality.

Civic Affairs:—Poona City Municipality was established in 1858. The present area in its jurisdiction is 4896 acres or $7\frac{3}{4}$ sq. miles. It is divided into some 18 Peths or wards most of them dating back to the Peshwas' days, a number being named by days of the week like Raviwar, Budhwar, Shanwar, some from illustrious names of the Peshwa family like Narayanrao or Sadashivrao. The present population is about 1,60,000. There are 50 councillors, of whom 45 are elected and 5 are nominated by Government. 5 councillors are elected by Mahodans, 2 by the depressed classes and 38 by the remaining population. The annual ordinary income is about 15 lacs of rupees and the normal expenditure is a little less. The Cantonment and Suburban areas are administered by separate local bodies. The Municipal Offices are located in the Vishrambag Wada in Sadashiv Peth, which was originally built by the last Peshwa in 1805 as a subsidiary residence for his household. The principal officers are the following:—(1) The Chief Officer, (2) The two Engineers, (3) the Health Officer, (4) the Assessment Officer, (5) the Octroi Superintendent, (6) the School Board Administrative Officer. Primary education is compulsory only in one fourth part of the city, which is inhabited by the backward classes. The expenditure on primary education amounts to $3\frac{1}{2}$ lacs of rupees per year. The number of pupils in municipal primary schools is about 12000 and that in aided schools is 7000.

Town Planning:—The Town Planning Scheme was started in 1916, and came into force on 1st March 1931. The area covered by the Scheme measures 1675 acres together with some additional area from the old city. The whole area has been divided into about 900 plots, some of which are again divided into sub-plots. Betterment contribution equal to half the amount of increase in value of each plot owing to the Town Planning Scheme has been recovered from each plot holder in a lump sum or in 10 instalments. Drainage and water-supply arrangements were not provided for in the scheme sanctioned by Government. But the Municipality has manag-

ed to provide from its current revenue both the above necessaries of city life in a considerable part of the Town Planning area, and the remaining parts will also be provided with drainage and pipe water as funds permit. The principal part of the development consists of roads. Nearly 9 miles of metalled roads have been already constructed in the last 2 years and the remaining roads will be constructed gradually in the coming 8 years. Markets, parks, play-grounds and other amenities of city life have been fully provided for in the sanctioned scheme and will be carried out as betterment contributions are received from year to year. The total estimated cost of the whole scheme is over rupees 22 lacs. Government have spent about 16 lacs for the construction of the Lloyd Bridge (which is an essential part of the scheme) and the Municipality has raised a loan of Rs. 2,60.000 for construction of the works laid down in the sanctioned scheme. Building byelaws applicable to the Town Planning area are much more drastic than those in force in the old city area and are enforced with great strictness as required by the conditions of the scheme.

PLACES OF INTEREST.

Shanwar Wada.—This was a magnificent mansion built by the Peshwas in the 18th century. The palace had five gates, four large courts and state-rooms as well as many other chambers and apartments for members of the Peshwa's family. The Durbar Hall was designed and built by Balaji Bajirao, the third Peshwa in 1755. The annual Ganapati festival used to be held here. All the military officers and sardars used to assemble once a year in the Shanwar Wada to pay their homage to the Peshwa. In 1782 the marriage of the Peshwa Sawai Madhavrao was celebrated here, when among the guests were the Nizam of of Hyderabad, the Raja of Nagpur, the Raja of Satara and numerous other chiefs and sardars. One Mr. Robert Mahon, an artist, who stayed in Poona during 1790–95 has recorded his impressions of the Durbar at Ganapati Rangamahal thus:

"I had the pleasure of being introduced to the durbar, or court of the Marathas. After waiting there some time, in conference with several Brahmins, attendants of the Peshwa, he made his appearance. I made a salaam to him, which he gracefully returned and advanced to the musnud or throne, on which he sat down, cross-legged, with attendants behind him, armed with swords, one of whom was his Chowree bardar, with a large Chowree, or whisk, in his hand to keep off the flies. In front of the Peshwa stood his Chopdar, with a long silver stick, ready to receive any orders he might be pleased to favour him with.

"I sat down at a distance in the attitude in which the Peshwa was, viz. cross-legged, as nothing is considered by him a greater piece of impoliteness than extending your legs, or sitting in any manner in which the soles of your feet might be pointed towards him. He was of a fair complexion and appeared to be about twenty-three years of age; his dress consisted of a long jama or gown of very fine muslin; a string of very large pearls hung from his neck, a considerable way down his waist; a very fine red shawl, with a rich embroidered border was thrown carelessly over his shoulders. He wore a beautiful cluster of diamonds, the centre one of which was about an inch square, of a very fine colour. On the top of his turban, he wore a small curvature of gold, about three inches high, richly set with emeralds and various precious stones; over the right

temple, from the top of the turban, hung several strings of pearls, which terminated at bottom by small red tassels. In this group, on the left, I was introduced to Nana Furnavees, his then Prime Minister, and formerly regent during the time the Peshwa was under age. It is to this sagacious politician that almost all ascribe the present flourishing state of the Mahratta Empire. His dress was much the same with that of the Peshwa but not so splendid.

"The musnud or throne, is raised from the ground about four inches, and consists simply of three pillows covered with dark green velvet, placed upon rich embroidered cloth. Before the Peshwa, upon this cloth is placed his 'cuttar' or dagger beautifully enamelled with various devices; next to it, a small urn and plate, made of copper enamelled and his goolab-dance for sprinkling rose water, richly set with diamonds; close to them, his betelnut box, which is so truly splendid and set so full of diamonds, that at a little distance, it appears entirely composed of them; naxt to it is placed a silver cup for his saliver on a towel; and last of all his sword and shield, the handle of the sword is green enamelled, full of diamonds, the scabbard is covered with red scarlet; the shield differs in no respect from the common Mahratta one, otherwise than that the fine studs upon it are gold which, in that of a person of inferior rank, would be plated, or perhaps plain brass.

"...The room in which the Peshwa thus sits in state, has nothing of beauty or elegance to recommend it; on one side is a row of wooden pillars, over which are hung purdahs, made of Kincobs, or gilt flowered silk, which are so constructed as to bind up or let down as occasion may require. Opposite to these pillars are a few windows made in the eastern mode, very narrow and long. The Durbar is a very extensive building built in a style peculiar to the Asiatics in general."

Shortly after the battle of Kirkee, which was fought on the 5th Navember 1817, that is after the departure of the Peshwa Bâjirao, the palace was occupied by the British and turned into a military hospital for a time. Ten years later on the 27th February 1827, the whole palace was completely burnt down by a great fire lasting for seven days. The heavy rampart, a few gateways and the ruins of the basement work of the

various structures inside are all that remain to bear witness to the rise and fall of a mighty Empire.

Sangam. — *Sangam* meaning the confluence of two rivers is a place in Poona where the Mula and Mutha rivers meet each other. Near the Sangam is a tomb or *samadhi* of a famous Mahratta bard named Saganbhau. There is also a temple in the vicinity with a Gopura in south Indian style. The Sangam is a place of considerable historical interest, because here Sir Charles Malet, the first British Resident built a house in 1787 at a place where at present stands the Judge's Bungalow. Malet obtained subsequently from the Peshwa the allotment of a piece of land for his permanent residence near the Sangam which he developed into a park with a beautiful building in the centre. A succession of Residents lived there, the last one being Mr. Mountstuart Elphinstone, who took up that office in 1810. During the political struggle that was going on, the Residency was attacked by the Peshwa's forces on 5th November 1817. A few hours previous to the attack Elphinstone evacuated the Residency and went to the camp at Kirkee. The Mahratta forces attacked the Residency and burnt it. In Elphinstone's time the Residency included the adjoining grounds of the present Engineering College as well as the English cemetery close to the present Sangam Lodge. The present "Judge's Bungalow" is a comparatively modern structure built on the ruins of the old Residency.

Scindia's Chhatri. — About three miles to the southeast of Poona in the village of Wanowrie is Scindia's Chhatri or tomb on the left bank of the Bahiroba stream. The great Mahadji Scindia of Delhi fame died at Wanowrie on the 12th February 1794 in his Camp. About 1830 his greatgrandson Jankoji Scindia commenced a large monument to his illustrious great-grandfather but it was not completed until the late Maharaja Madhavrao Scindia of Gwalior (the father of the present Maharaja) finished it at a cost of several lakhs of rupees comparatively recently. The memorial is maintained by the Gwalior Durbar.

Ambarkhana or the Lalmahal Palace. —Near Shanwar Wada. Built by Shahaji Raje Bhosle in 1636 for his wife Jijabai and his son Shivaji. It was in this place that Shahistekhan who had

taken temporary occupation of it, was surprised by Shivaji in a night sortie from Sinhagad. In the melee that followed the attack Shahistekhan escaped through a window with fingers cut. At presesnt only a garden exists at the site where the building stood.

Tophkhna. — In Shukrawar Peth, was the headquarters of the Peshwa's artillery. It was in charge of the Panse family and the house of Sardar Panse is still there.

Khajina Well: — is a good specimen of a large well, covered up with a building, including a talimkhana or gymnasium, and having an arrangement to carry water up to the highest step. In the old days it used to be surrounded by a garden. It is said that Mashir-un-Mulk the Minister of the Nizam of Hyderabad, who had insulted the Peshwa and who was demanded as a hostage by the Mahrattas after the defeat of the Nizam at Kharda in 1795, was kept here.

Pāndha'ri or Juna Kot. — This was an ancient fort surrounding old Poona which then comprised only of the area of the modern Kasba Peth. The Fort was said to have been built by one Badya Arab, commandant of Poona, when the place was a military station under the Mahomedans in the 14th century. Inside the fort was the shrine of Baloba, still exsting in ruins, and looked upon as a family deity by some old families of Poona. In 1430 Murar Jagdeo, the Bijapur minister pulled down the fort and dug up the place with ploughs driven by asses. Six years later, it passed to Shahaji Bhosle as a Jahagir and his agent Dadaji Konddeo plied a golden plough over the area to indicate the return of prosperous times.

Garpir.—Pir signifies the shrine of Mahomedan saint. The saint concerned in this Garpir, is said to have been the very first Mahomedan to visit Poona about the time of the two Sheikh Sallas (circa 1290 A. D.; see description later on). The shrine is a curious heap of white and pink quartz crystals. It is possible, they say, that a Shivalingam might have existed here before the shrine of pir was put up. During the regime of the Peshwas armies used to assemble near Garpir annually, just before they started on their *mulukhgiri* expeditions. In 1803 General Wellesley encamped the British forces at Garpir for some time

MANSIONS.

There are a number of old mansions or wadas in Poona built at various times by the Peshwas or their chiefs and sardars. They were usually solid structures with very thick walls almost like miniature fortresses. They had their own grounds and places for the cavalry mounts and elephants and beasts of burden and so on. Most of them now present quite a changed appearance often changed for very much the worse, because of the vastly altered conditions of life of their present owners, compared to those of their original owners when they were active and living forces in the Maratha State. Some of the principal wadas are described briefly below.

Budhwar Wada.—In Budhwar Peth. Built for public offices by Bajirao, the last Peshwa in 1813. It was burnt down by fire in 1879. Attached to the Wada was a Faraskhana for keeping horses and elephants. This was saved from the fire of 1879 and is now used as the City Police Headquarters.

Vishrambag Wada.—A palace built as a residence by Bajirao the last Peshwa between 1803 and 1809 at a cost of some two lakhs of rupees. Its entrance with a "*Meghadambari*" presents a fine appearance. In 1821 a Pathashala was established here from the Dakshina Fund of the Peshwas. The study of English was introduced in 1842 and Major Candy was the first Principal of the Poona College as it came to be called. The Poona College became in 1856, the Deccan College. At present the Wada belongs to the Municipality and its offices are located there.

Ghashiram's Wada.—Ghashiram, a notorious Kotwal (corresponding to the Police Chief) of Poona (1742–91) had his mansion to the west of the Reservoir near St. Mary's Church. Part of a two-storeyed building with ornamental stone arches and pillars overhanging stone windows are still standing. They formed part of the entrance of Ghashiram's Wada.

Nana Wada:—Built by the famous minister of the Peshwas Nana Phadnis for his own residence in Budhwar Peth, just to the south of Shanwar Wada. The front hall and the Meghadambari room have been preserved in good condition. It is now

occupied by the New English School of the Deccan Education Society.

Morobadada's Wada.— Morobadada Phadnis was a cousin of Nana Phadnis and was also Prime Minister for a short time to the Peshwa Sawai Madhavrao. His mansion, now in ruins, is perhaps the best specimen of fine woodwork of those days. Trellis work, cypressed pillars, panelled-arches all of wood, a plinth of polished stone, large cisterns and an ivory hall (Hastidanti Diwankhana) were its chief features once upon a time.

Haripant Phadke's Wada.—In Raviwar Peth. Belonged to the Mahratta General Haripant Phadke. Now in ruins.

Ghorpade Jalamandir.—In Aditwar Peth. Built on pillars in water.

Raste's Wada:—Built between 1779 and 1784 at a cost of some nine lacs of rupees by Anandrao Bhikaji Raste, the officer commanding the Peshwa's cavalry. The mansion had its own water-supply brought through an aqueduct from Wanowrie. It is still in a fairly good state of presevation.

In addition to these mansions there are a number of others in varying degrees of preservation and repair, belonging to different Chiefs and Sardars, such as Jamkhedkar, Holkar, Sanglikar, Mehendale. Chhatre, Panse, Purandare, Sachiv, Shirke, Gadre, Mujumdar, Gaikwad and Darekar.

Among modern buildings some of the noteworthy structures are, the Council Hall, a two storeyed structure in Venetian-Gothic style constructed in 1869. The Central Offices, the new Judges Courts, H. H. the Aga Khan's Palace at Yeravada and the Parnakuti the palace of the Thackersey family on a picturesque hill near the Bund. Other buildings like the Government House and Meteorological Office have been mentioned elsewhere.

Places of Worship etc.—As a Hindu City of long standing, Poona has a large number of temples. Some of them are quite interesting and in picturesque localities. The most important ones are mentioned below after which a description of places of worship of other religious denomintions is also given.

Panchaleshwar:—Also called Pataleshwar; this is a rock-cut cave temple in Bhamburda situated between the Shivaji Statue

and the Meteorological Office. It has huge pillars and a shrine of Shiva in the centre with a Nandi in front under a circular canopy. The temple of one Jangli Maharaj (presumably so-called because the Sadhu who developed the temple was staying in this locality which was more or less a jungle a few years ago) is also adjoining this cave temple.

Parvati:—On the south-western outskirts of the city on a hill over 250 feet high. There are a number of temples one of which is dedicated to Parvati. The others are dedicated to various deities such as Mahadeo, Ganapati, Devadeveshwar, Surya and one rather curious one, dedicated to Kartikswami. The hill commands a beautiful view of the city and the plains beyond. The way from base to top is paved with huge flags of stone. At the foot of the hill is the place called *Ramna* where in the days of the Peshwas in the month of Shravan, thousands of Brahmins from all parts of India used to assemble to receive *dakshina*. A little beyond the *Ramna* was an artificial lake, with gardens called Sarasbag and Hirabag. The lake is now dry. Sarasbag is only a name, and at Hirabag there is a club of the elite society of the Poona City. The temples contained several ancient idols of gold worth lakhs of rupees, which were stolen last year, by some unknown agency which has not been traced.

Padmavati.— Three miles from Poona on the Satara Road. A small temple with an adjoining tank the water of which is supposed to possess curative properties.

Chatushringi.—On the hill called by the same name about three miles to the northwest of Poona, off the Ganeshkhind Road. Tradition connects the temple with one Durlabhshet, a rich banker, who maintained a mint in Poona. He was asked to worship Chatushringi as this goddess was supposed to represent the other famous goddess on the Saptashringi hill near Nasik.

Onkareshwar.— Dedicated to Mahadeo, with a large quadrangle surrounded by verandahs with a *nagarkhana* or drum-house in front. The temple was built between 1740 and 1760, by one Chitrao with the help of Sadashivrao alias Bhausaheb, a cousin of the third Peshwa Balaji Bajirao (1740–1761). Just near the

temple on the river side is the cramation ground for Brahmins, between the Lloyd Bridge and the Lakdi Bridge.

Ganapati :—In Kasba Peth. Pillars outside are in what is known as *Hemadpanti* style. This temple is said to have been built by Jijabai, the mother of Shivaji. It is considered important by the orthodox community who believe this Ganapati to be the guardian deity of the town.

Amriteshwar :—In Shanwar Peth, built by Bhiubai, a sister of Bajirao Peshwa.

Narpatgir :—In Somwar Peth. Under the later Peshwas, the sect of Gosavis assumed considerable importance, both as traders as well as fighters. A special ward called Gosavipura in Somwar peth belongs to them and here one of them Saint Narpatgir Gosavi built this temple.

Nageshwar :—Is one of the oldest temples in Poona. Legend says that the famous Mahratta saint Dnyaneshwar used to bathe in the well near this temple. Nageshwar is referred to by the saint Namdeo (Circa 1300 A.D.) in his devotional compositions.

Among other temples may be mentioned Tambadi Jogeshwari, Bhavani in Bhavani Peth, Khunya Murlidhar and Narsoba in Sadashiv Peth, Vithoba near Lakadi Pool, Someshwar in Somwar Peth, Rameshwar and Vishnu in Shukrawar Peth, Tulshibag (temple of Rama) in Shukrawar Peth, Belbag built by Nana Phadnis in Budhwar Peth etc.

MAHOMEDAN.

Jumma Mosque :—In Aditwar Peth. The chief Mahomedan place of worship, built in 1839.

Bohori Jamatkhana :—This is a meeting house for the Bohori sect of Mahomedans, originally built about 1730. Additional buildings appeared from time to time. There is a large tank and a mosque with cypressed pillars. The building is now being used for a residential school for Bohori children called "Madrasa Badaria".

Two Shaikh Sallas :—The elder (*thorla*) and the younger (*dhakata*). Two *durgas* said to be as old as 1290 A D. on the bank of the Mutha standing on the site of two old Hindu temples Puneshwar and Narayaneshwar, near Lloyd Bridge.

Angadshah's Takya :—In Bhavani Peth. Angadshah is said to have been a Mahomedan saint of the times of Tukaram. Mambaji Gosavi who persecuted Tukaram had been directed by Angadshah to seek pardon of the Mahratta saint which he did after repentance as soon as he felt a burning sensation after bathing in the well near the Takya of Angadshah.

JAIN.

Parasnath :—in Vetal Peth. A group of four temples of the Jains who were allowed to build temples by the Peshwas in 1750.

JEW.

Synagogue :—A red-brick building with a high tower to the south of the Poona Post Office in the suburban municipal area built in 1867 by the late Mr. David Sassoon.

CHRISTIAN.

St. Xavier's Church :—Convent Street, Sadar Bazar.

St. Paul's Church :—Built by Government after the style of St. Chapel in Paris in 1867, for Civil and Military Officers.

St. Mary's Church, St. Patrick's Cathedral, St. Andrew's Church.

PARSEE.

Sir. J. J. Fire Temple and Sardar Dastur's Fire Temple in Camp; Tower of Silence about 100 year's old, on the Gul Tekdi, a small hill on the southern outskirts of Poona.

INTERESTING PLACES IN THE ENVIRONS OF POONA

Matheran :—On the way from Bombay to Poona on the western side of the Ghats about 65 miles from Poona is a hill called Matheran about 2500 feet high. It is an agreeable summer resort and has a number of 'points'. Passengers for this hill leave the train at Neral station. There is a 2 feet gauge steam tramway leading up to the hill.

Khopoli :— Power generating station of the Tata Hydro-Electric Scheme. (See under Bombay portion.)

Khandala and Lonavala. — About 40 miles from Poona, on the top of the Bhor Ghat, are also popular summer retreats.

Karla Caves :—About 30 miles to the north-west of Poona. The nearest railway station is Malavli about four miles from

the caves. There is a very large main cave as well as numerous *Viharas*. The excavations are probably two thousand years old. There is a comparatively modern temple of Ekaveera, a goddess worshipped by the Kolis or fishermen, and Probhus. The following abstracts of Mr. Fergusson's description of the caves (Rock-cut Temples of India) are *interesting:—

"The cave of Karli is certainly the largest, as well as the most complete, chaitya cave in India, and was excavated at a time when the style was in its greatest purity and is fortunately the best preserved. Its interior dimensions are 124 ft. 3 in., in total length, 81 ft. 3 in. length of nave. Its breadth from wall to wall is 45 ft. 6 in., while the width of the central aisle is 25 ft. 7 in. The height is only 46 ft. from the floor to the apex." + + + + "The building resembles an early Christian church in its arrangements, while all the dimensions are similar to those of the choir of Norwich Cathedral." ' The nave is separated from the side aisles by fifteen columns with octagonal shafts on each side, of good design and workmanship. On the abacus which crowns the capital of each of these are two kneeling elephants, and on each elephant are two seated figures, generally a male and female, with their arms over each other's shoulders, but sometimes two female figures in the same attitude. The sculpture of these is very good, and the effect particularly rich and pleasing. Behind the altar are seven plain octagonal piers without sculpture, making thus thirty-seven pillars altogether, exclusive of the Lion Pillar in front, which is sixteen-sided, and is crowned with four lions with their hinder parts joined. The dagoba is plain and very similar to that in the large cave at Ajanta, but here, fortunately a part of the wooden umbrella which surmounted it remains. The wooden ribs of the roof, too, remain nearly entire, proving beyond doubt that the roof is not a copy of a masonry arch : and the framed screen, filling up a portion of the great arch in front, like the centring of the arch of a bridge (which it much resembles), still retains the place in which it was originally placed. At some distance in advance of the arched front of this cave is placed a second screen, which exists only here and at the great cave at Kanheri, though it might have existed in

*See Murray's handbook for India, Burma and Ceylon.

front of the oldest chaitya caves at Ajanta. It consists of two plain octagonal columns with pilasters. Over these is a deep plain mass of wall, occupying the place of an entablature, and over this again a superstructure of four dwarf pillars. Except the lower piers, the whole of this has been covered with wooden ornaments; and by a careful examination and measurement of the various mortices and footings, it might still be possible to make out the greater part of the design. It appears, however, to have consisted of a broad balcony in front of the plain wall, supported by bold wooden brackets from the two piers, and either roofed or having a second balcony above it. No part of the wood, however, exists now, either here or at Kanheri. It is more than probable however, that this was the music gallery or Nakkar khana, which we still find existing in front of almost all Jain temples, down even to the present day. Whether the space between this outer and the inner screen was roofed over or not is extremely difficult to decide. To judge from the mortices at Kanheri, the space there would seem to have had a roof; but here the evidence is by no means so distinct, though there is certainly nothing to contradict the supposition. There are no traces of painting in this cave, though the inner wall has been plastered, and may have been painted, but the cave has been inhabited, and the continued smoke of cooking-fires has so blackened its walls that it is impossible to decide the question. Its inhabitants were Saivites, and the cave was considered a temple dedicated to Siva, the dagoba performing the part of a gigantic lingam, which it resembles a good deal. The outer porch is 52 ft. wide and 15 ft. deep. Here originally the fronts of three elephants in each end wall supported, a frieze ornamented with a rail pattern, but at both ends this has been cut away to introduce figures. Above was a thick quadrantal moulding, and then a rail with small facades of temples and pairs of figures.

" It would be of great importance if the age of this cave could be positively fixed; but though that cannot quite be done, it is probably antecedent to the Christian era; and at the same time it cannot possibly have been excavated more than 200 years before that era. From the Sinhastambha (lion pillar) on the left of the entrance Colonel Sykes copied an inscription,

which Mr. Prinsep deciphered in vol. 6 of the Journal of the Asiatic Society. It merely says: 'This lionpillar is the gift of Ajmitra Ukas, the son of Saha Ravisabhoti'; the character, Mr. Prinsep thinks, is of the 1st or 2nd century B. C. From its position and import the inscription appears to be integral and the column is certainly a part of the original design. I am inclined to think the date, 160 B. C., is at least extremely probable.

"It would be a subject of curious inquiry to know whether the woodwork now existing in this cave is that originally put up or not. Accustomed as I had long been to the rapid destruction of everything wooden in India, I was half inclined to be angry when the idea first suggested itself to me; but a calmer survey of the matter has convinced me that it is. Certain it is that it is the original design, for we find it repeated in stone in all the niches of the front, and there is no appearance of change or alteration in any part of the roof. Every part of it is the same as is seen so often repeated in stone in other and more modern caves, and it must, therefore, have been put up by the Buddhists before they were expelled; and if we allow that it has existed 800 or 1000 years, which it certainly has, there is not much greater improbability in its having existed near 2000 years, as I believe to be the case. As far as I could ascertain the wood is teak. Though exposed to the atmosphere, it is protected from the rain, and has no strain upon it but its own weight, as it does not support the roof, though it appears to do so; and the rock seems to have defied the industry of the white ants."

Vadgaon.—About 25 miles from Poona near the railway line. Now a large and flourishing village. Celebrated for the defeat of a British force under Lt. Col. Cockburn in January 1779 and for the *convention* concluded there by Mr. Carnac with the Marathas.

Talegaon.— A few miles to the southeast of Vadgaon. Has a fairly large glasswork factory, of about 20 years' standing.

Kirkee.— A little over three miles from Poona to the north. Practically a part of it. Historically the interest attaching to this place is because of the last battle of the last Peshwa Bajirao II with the British forces on the 1st November

1817. Kirkee is at present the head quarters of a brigade of field artillery and there is also a Small Arms Ammunition Factory and Arsenal.

Koregaon:—On the Bhima river about 20 miles from Poona is noted as a battlefied of importance. On the 1st January 1818, the last Peshwa Bajirao was encamped on the right bank of the river Bhima, opposite Koregaon. Captain Staunton who marched to this place from Shirur, was surprised by the Maratha forces, but effected an entry into the village and took up a position of vantage with his 800 picked men. He held on bravely for 12 hours until ultimately General Smith approached from the north and Bajirao left the place.

Ganeshkhind:—1½ miles southwest of Kirkee and 3½ miles northwest of the City of Poona. *Khind* means a pass. On one side of this Ganeshkhind is the Chatushringi Hill. At Ganeshkhind is located the Government House. It resembles a modern French chateau and has a tall slim tower 80 feet high. The House contains the usual reception rooms, a ball-room, durbar room etc. and has a flower gallery or a garden corridor 90 ft. long. Beyond Government House, as one passes from Poona are the extensive Government Botanical Gardens.

Pashan:—Interesting on account of a small reservoir of water made by damming a stream, surrounded by hills. The Pashan reservoir supplies water to the Government House at Ganeshkhind.

Katraj:—About 11 miles from Poona on the Satara Road. At the foot of a Ghat known by the same name. It contains a reservoir of water dating back to the days of the Peshwas who had built a large conduit from here to the city of Poona for water supply. It is a good specimen of skilful engineering of those old days. In the present times the water supply from this tank is neither sufficient for the City, nor very good. The reservoir is at present under the City Municipality and its water supply is used as a supplementary source only in case of emergency, the normal supply coming from Khadakvasla Lake.

Dehu:—About 13 miles from Poona, three miles from Shelarvadi railway station on the banks of the Indrayani river. It is the birthplace of the famous Maratha saint, Tukaram. A

great fair is held here in the month of Falgun, on the anniversary of Tukaram's death.

Alandi:— About 12 miles from Poona on the Poona-Nasik Road. Holds the Samadhi and temple of Saint Dnyaneshwar, the founder of the Bhakti cult in Maharashtra, in the last quarter of the 13th century, and the author of the famous Dnyaneshwari, a commentary on the Bhagvadgita. Next to Pandharpur, Alandi is a great centre for pilgrims who assemble here annually on the Kartiki Ekadashi (November-December).

Shivneri:—Near Junnar about 56 miles from Poona, is an old fort and is famous as the birth-place of Shivaji.

Sinhagad:—About 15 miles to the southwest of Poona. On the way to it about 12 miles from Poona is the Khadakvasla Lake which supplies water to the City and Cantonment of Poona. The old name of Sinhagad was Kondana. This was perhaps a corruption from Koundinya because at the foot of the Fort is a village now called Kondanpur (Koundinyapur ?). At Kondanpur, there are some very old temples which used to be visited by people to offer sacrifices of goats by the thousand annually, to to goddess there. In 1340 a Koli Chieftain Nagnaik resisted Mahomed Taghlak for 8 months at Sinhagad. In 1486, the fort was taken by Malik Ahmed, the founder of the Ahmednagar dynasty. Shivaji's father held the fort on behalf of Ahmednagar for a time. Sinhagad was one of the earliest forts captured by Shivaji. It was from here that he went out in the dead of night to surprise Shahistekhan in Poona and returned immediately the same night after a successful sortie. The fort was handed over to Jai Singh when he was deputed by Aurangzeb to these regions in 1665. In 1670 Shivaji decided that it was necessary to capture Sinhagad from Uday Bhanu the then Moghul commander of the Fort. The task was undertaken by his right-hand man Tanaji Malusra, who successfully scaled the walls by ropes led up by trained ghorpads (large lizard like reptiles) at the steepest precipices, with a small party of supporters, and threw open the gates for the entry of the Maratha forces. After a severe hand to hand fight, in which Tanaji lost his life, the Marathas got possession of the Fort. Sinhagad as well as the other three forts Purandhar, Rajgad and Torna were very important strategic points, in these territories. In

1703 Aurangzeb captured the fort. In 1706 the Marathas under Shankraji Narayan Sachiv took it again but lost it later to the Mogul General Zulphikarkhan. Sachiv once more recaptured it. Ultimately in 1788 the Peshwa exchanged the hill forts of Tung and Tikona for Sinhagad. In critical times, the Maratha Government used to carry their valuables and specie and so on to Sinhagad for safe custody. In March 1818, when General Pritzler captured the fort from the Peshwas, " Prize property to a vast amount consisting of pearls and diamonds said to have been removed for safety by Poona merchants was found in Sinhagad. Many of the soldiers carried about for several days hats full of pearls, jewels and gold ornaments for sale without knowing their value, being anxious to exchange them for money or exchange bills on Bombay ere prize agents should discuss the plunder. Along with other treasure a golden image of Ganesh was found hidden in a masonry pillar in Sinhagad fort. It was said to be worth £50,000 (Rupees five lakhs) and a ransom of 15,000 pounds was offered for it."

The hill top is some 4200 feet above the sea level. From the Poona side one ascends the hill towards the Poona Darwaja of the fort. The ascent is very difficult. The ascent from the Shivapur or Kondanpur side is easier. This way leads to Kalyan Darwaja and this was the side by which Aurangzeb had attacked it. At present one sees on the top of the hill a small plain tomb dedicated to Tanaji. King Rajaram died at Sinhagad in 1700 and his *samadhi* also to be seen there. None of the old buildings inside the fort are standing now; but ruined plinths and under-ground chambers now filled with water are all that remain. There are a few modern bungalows occupied in the summer by visitors from Poona, because Sinhagad is delightfully cool in the hot weather.

Purandhar. — This is another hill fort about 17 miles to the southeast of Poona as the crow flies, and 24 miles by road. It is reached by Babdeo pass or the Diwa Pass via Saswad ; the latter is motorable. Purandhar is separated by a narrow ridge from the adjoining Vazirgad or Vajragad. The fort is said to have been in existence from the Bahamani times and was one of the earliest capturesof Shivaji. In the days of Peshwa Sawai Madhavrao, Purandhar was the real seat of Government. The

summit of the hill is 4560 feet above sea level and the fort is some 300 feet below the summit. It is still used as a sanatorium by summer visitors and is a convalescent depot for troops.

The Lloyd Dam at Bhatgar:—The following information about the great engineering feat at Bhatgar, some 30 miles from Poona has been extracted from a brochure published on the occasion of the opening of the dam in October 1928 by Sir Leslie Orme Wilson, the then Governor of Bombay.

The irrigation works in the Bombay Deccan are fundamentally different from those in Sind, the Punjab, Egypt or Mesopotamia, where wide alluvial plains have been formed by very large deltaic rivers in perennial flow. The Bombay Deccan consists of a sloping tableland running eastwards from the ridge of the great geographical feature of western India, the Western Ghats. These form a ridge, running parallel to the sea-coast at a distance from it of 520 miles; precipitous on the western side, they fall away more gradually to the east. The heaviest rainfall occurs on the peak of the Ghat ridge where anything upto 250 inches or more of rain are recorded in the four monsoon months. The intensity of rainfall very rapidly decreases as we go eastward from the highest ridge, reaching a figure of 20 or 25 inches at a distance of 100 or 150 miles east of the Ghats. The rivers in the Bombay Deccan rise in the valleys close to the ridge, flow in an eastward direction and are dry or practically so for seven or eight months of the year. The line of the Ghats like the ridge of a roof divides rainfall into two parts; one, the smaller portion, falling westward into the Indian Ocean and the other flowing through long lengths of tortuous rivers to the east and joining the rivers which reach the sea on the southeastern coast of the Peninsula. These rivers are in flow during the monsoon months only and if no artificial means of conserving their waters were provided the whole monsoon rainfall would be wasted, so far as the Bombay Deccan is concerned, and would simply flow away to the sea benefiting to but a small extent the counrty traversed.

The Lloyd Dam has been built across the valley of the Yelwandi river near its confluence with the Nira river, thereby forming a large reservoir in the Yelwandi valley.

The Dam.—The length of the dam is 5333 feet, its maximum height 190 feet, width at base 124 feet; its construction cost Rs. 172 lakhs. It is remarkable as being the largest dam in volume hitherto constructed; it contains 21½ million cubic feet of masonry. The Assuan Dam in Egypt is popularly supposed to be the largest dam in existence. But that contains only 19 million cubic feet, while it cost nearly 50 per cent. more than the Lloyd Dam. An idea of the magnitude of the Lloyd Dam can be gathered from the fact that if a wall 6 feet high and 15 inches thick were constructed from the masonry in the Dam, it would stretch a distance of 520 miles, say from Bombay to Nagpur.

The Lake:—The lake is 17 miles long with a perimeter of 46 miles. Its area is 14·7 sq. miles and contents 24198 million cubic feet or 150 thousand million gallons. The catchment area is 128 sq. miles and the rainfall varies from 250 inches in the hills to 40 inches at Bhatgar. The lake is nearly as large as the island of Bombay and its contents could cover to a depth of one foot an area of 555,510 acres or 868 sq. miles.

The Canals. — The canals that are fed by the lake are the Nira Left Bank Canal which is 100 miles in length and the Nira Right Bank Canal, 106½ miles. Between them, they command an area of 834,104 acres, of which it is estimated, approximately 202,000 acres will be irrigated annually. The Canal Head Works are situated at Vir on the Nira River 17 miles downstream from the Dam. During the monsoon months, the river-flow is usually sufficient but stored water has to be used for the rest of the year. It is let out from the sluices in the Dam and flows down the river and is diverted into the canals by the weir at Vir. A programme is prepared of the water required for the crops to be irrigated and special telegraph and telephone lines are constructed all over the area to ensure correct distribution and to avoid waste of valuable water. The principal crops irrigated are sugarcane, fruit trees, vegetables, bajri, jowari, groundnuts, cotton, etc. The canals protect from famine an area that is particularly liable to drought and the scheme which is classed as a protective one was estimated to cost Rs. 557·02 lakhs and to give a net direct return on outlay of 3·02 per cent. The indirect benefits to the country generally cannot be

estimated with accuracy, but the increased productivity of the irrigated area will be a most valuable asset. The following figures give an idea of the tonnage and value of crops likely to be raised annually, as estimated at the time of the opening of the Dam:—

Sugarcane, 780,000 tons, valued at	Rs.	1,95,00,000
Grain, 76,000 tons, valued at	Rs.	60,80,000
Cotton, 3,500 bales or 1,890 tons, valued at	Rs.	10,50,000
Gur, 91,863 tons, valued at	Rs.	5,64,95,745
Nuts, 20,900 tons, valued at	Rs.	56,43,000
Fruit, 1,100 acres, valued at	Rs.	55,000
Total estimated annual value of crops	Rs.	3,23,28,000

The *Waste weir* has 81 gates 10′ x 8′ (45 automatic and 36 of the rolling type), for regulating and controlling the flood level in the lake. The automatic gates are connected by chains passing over pulleys to counter-weights. When a counter-weight is suspended the air, its weight is 1,000 pounds more than that of a gate but when the counter-weights are submerged, the weight of a gate exceeds that of a counter-weight by about 1,000 pounds. When water rises above F. S. L. in the lake, it flows through openings in the masonry which connect with the counter-weight chambers, and as these fill the counter-weights float and as they rise the gates fall, allowing the water to discharge over their tops. The counter-weight chambers have a small drain which allows the water to drain off as soon as the flow from the inlet ceases and when the counter-weight chambers are emptied of water the counter-weights become heavier than the gates and pull them back to the closed position.

Construction:—The Dam is constructed entirely of rubble masonry in lime mortar. For the main bulk of the Dam, trap rock of excellent quality was obtained from quarries in the vicinity, but for the face work special stone of great durability, called 'Kar Boulderstone' was selected from distances up to 10 miles away. The transport of materials (stone and mortar) was effected by 24 miles of light railway and by a steam launch with six large barges for bringing materials from the shores of the lake.

Hydraulic lime was burnt from specially selected lime-stone at depots situated 12 to 25 miles distant and was trans-

ported by carts and motor lorries to the site of the works. Natural sand was not obtainable in the vicinity, so trap stone was crushed to make sand and the lime and sand were mixed together at site by power-driven mortar mills to form mortar. Advantage was taken of the water stored by the old Bhatgar Dam to develop power by electricity, and the whole of the plant on the work was driven electrically at 2,000 volts A. C. As the Dam increased in height it became a most urgent matter to devise means for raising the materials, as on account of the great length of the Dam, they could not be run on to the work from each end. To cope with this situation, special electrically-operated elevators, which could be raised as the work proceeded, were devised by Mr. Pooley.

The plant was laid out to enable 15,000 cubic feet to be laid daily, and the sand-crushing and mortar-crushing machines were located in four batteries, each consisting of ten mortar pans and two sand-crushing plants, the whole being electrically operated. In order to keep the plant in proper running order a workshop and foundry were established with most satisfactory and economical results. It is calculated that the use of electric power has effected savings which have more than paid for the entire cost of the installation.

Power House. — A Power House was constructed to supply electrical energy to the works during construction, and the saving effected by using electricity instead of coal or oil has, as already mentioned, more than paid for the plant. The plant consisted of 4 units, each of 256 killowatts. Water from the main pipe was distributed to each turbine, entered the turbines at their peripheries and issued from their centres to the down-take pipes. The turbines were of the Francis type (mixed flow, re-action) and were designed to work with heads of water varying from the greatest to the least depth of water occurring in the lake at different seasons. Regulation was effected by oil pressure governors so arranged that in case of a break-down a unit could be closed within 10 seconds. These governors also regulated the amount of water entering the turbine according to the power required, thereby maintaining a constant speed. The turbines were directly coupled through a flexible coupling to alternators of 2,000 volts, 3 phase, 50 cycles,

and the alternators were excited by direct-current generators of 65 volts pressure. The switch board consisted of separate panels, one for each unit, so that any unit could be started or stopped when desired. Synchronisation of the units and regulation of the field excitation were effected by the controlling gear on the platform.

Thermometer House.—The thermometers, which consisted of a platinum wire wound on a quartz rod and suitably encased, were built into the heart of the masonry of the Dam, and were connected with the instruments by copper cables. The function of the instruments was to record the temperature continuously, and this was done by measuring the resistance of the platinum wire in the thermometers, the resistance of which varies directly with the temperature. The results of the observations show that in the centre of the Dam the temperature is now practically uniform at 70° F. throughout the year (against 76° when the masonry was newly laid). Near the face, however, the temperatures vary considerably, and especially is this the case on the downstream face which is more exposed to the sun. There the variation is as much as 18° (78° to 96° F.) at a point 18 inches inside the masonry.

The experiments give the following practical results:—

(1) In thin masonry walls the variation in temperature and therefore stresses due to temperature are considerable, but in walls of over 10 feet thick the stresses due to temperature are almost negligible.

(2) The materials with which the Lloyd Dam is built have a very low coefficient of expansion, namely, 0·00000370 for trap rock in lime mortar. But in future we may have to build high and long Dams in cement concrete which has a much higher coefficient of expansion (0·00000979), and our experiments show that had we used cement concrete, expansion joints to allow of movements of one quarter of an inch would have been necessary at every 50 feet along the Dam.

Test of Materials.— In constructing a high Dam great care has to be taken that the materials used are of first class quality and of ample strength. The actual maximum intensity of compressive stress in the Dam is calculated to be 245 lbs. per square inch

on a plane normal to the resultant of pressure, and allowing for a factor of safety of 5, a compressive strength of 1,225 lbs. per square inch is required in the masonry. The mortar was tested, both for strength and hydraulic properties, continuously during the progress of the work, and the results showed that there was an ample margin of strength in excess of that required. The weight of the rubble masonry in the Dam, including that of the lime mortar (1 of lime to 2 of sand), is 164 lbs. per cubic foot, as ascertained by actual tests, against 150 lbs. assumed in the calculations for stability, and the weight of the water was taken at 64 lbs. per cubic foot to allow for increased weight due to silt in suspension.

Some difficulties encountered: — The foundations were fairly straightforward, except in the river bed itself where a bad patch of red rock was met, which entailed going 40 feet below that level. A spring also gave trouble, and had to be given an outlet to avoid the danger of upward pressure under the base of the Dam. A particularly difficult matter during the progress of the work was that of arranging for water for the canal and passing a supply over the foundation trench of the Dam. A great deal of water was met with in the foundations and had to be pumped out, and certain fissures and dykes were encountered in the foundation trench which required special care and treatment. Up to 5,000 men were employed on the work, and special labour camps and a bazar were established and a police force maintained to keep order.

In the early years of construction the Great War affected progress very considerably. An aerial ropeway for bringing lime 24 miles from Diva beyond Purandhar had to be abandoned entirely, and the electric plant from Switzerland, captured at Antwerp but eventually rescued and reshipped from Genoa, took more than a year for the journey to India.

The work was done departmentally, by petty piecework, under the direct supervision of the Executive Engineer. This resulted in great economy, as no contractor had found it possible to tender within the estimated rates; whereas the work was actually done with a saving of some Rs. 3 lakhs on the estimated cost. When the work was first started a contract for part

of the excavation was given to a Pioneer Regiment from Kirkee with excellent results, but they had to leave for active service after a few months. Later certain Criminal Tribes were employed and did useful work, though it was found rather difficult at times to handle them.

Work was first started on the Lloyd Dam at the end of 1912, and the amount of work to be done annually was decided according to a programme so arranged that water would be available when required by the canals, as the canals and their distributary systems, which extend over a very large area of country, take very much longer to construct than a masonry Dam, which could have been finished much earlier had it been necessary. These works were financed from loan funds since the year 1918, on which interest is payable, and so it was very necessary not to expend more money, and incur interest charges thereon, till such time as the additional storage could be utilised to obtain revenue from the canals. The working season at Bhatgar is limited to seven or eight months annually on account of the heavy rainfall during the monsoon months. Many local men who previously were unskilled workers have been trained as Masons and Fitters, and others have been trained to look after machinery of various types. By training local men considerable economy and very satisfactory results have been obtained much to the advantage of the men themselves, and also to the country at large. At one period during the construction of the work, progress was considerably hindered owing to political propaganda by agitators from outside, who working on the credulous nature of the local populace induced some of them to resort to passiv resistance and refuse to allow stone to be removed from their lands and transported to the works. At one time the situation was serious, but luckily there was a sufficient stock of materials at site to enable the work to continue for the time being and the people who did not wish their stone to be removed were told that the stone could remain where it was in their fields and that arrangements would be made to obtain it from elsewhere. In this matter the Bhor State gave very valuable assistance by allowing new qnarries to be opened in State lands and when the people saw that the stone from their fields was not

essential they soon came to terms and allowed the work to proceed. Some hardship was inevitable owing to the necessity of acquiring land now submerged by the lake, but great care was taken throughout to ensure that full and fair compensation was granted in all such cases. Offers were made of Government lands in the canal tracts in exchange for lands thus acquired, but only a few persons took advantage of these offers, as the majority preferred to remain in their own villages and to accept compensation in cash for their lands and houses. Altogether 39 villages and 5,068 acres of land were acquired and compensation amounting to Rs. 7,18,593 was paid in cash.

APPENDIX.

RECENT SCIENTIFIC RESEARCH IN THE COLLEGES OF THE BOMBAY PRESIDENCY

The following short account of the recent research work done in the Colleges in this Presidency, in Mathematics, Physics, Chemistry, Botany, Zoology, Geology and Agriculture was prepared by Dr. K. G. Naik, M. A., D. Sc., F. I. C. Professor of Chemistry Baroda College, in collaboration with Prof. M. D. Avasare, B. A., M. Sc., Ph. D. (London), Dr. C. C. Shah M. Sc., Ph. D. (London), and Dr. R. K. Trivedi M. Sc., D. Sc.

MATHEMATICS.

Work has been published on the motion of (i) a Spheroid, (ii) a general Ellipsoid and (iii) a Sphere, in a viscous liquid. A new convention of Equality and Addition of Matrices, Theory of Intermittent Action in relation to Band Spectra and a Theory of Line Spectra, have been developed. A modification of Gibb's Statistics has been attempted. (Dept. of Mathematics and Physics, Rajaram College, Kolhapur.)

PHYSICS.

In the Physics Department of the Royal Institute of Science various physical properties of liquid amalgams of a number of metals at different concentrations have been studied with a view to understand the nature of the amalgam, and used to test different hypothesis put forward from time to time. Investigations on the formation of cloud drops, their size, the dependence of the size on the nature of the nuclei and transmissibility to lights of different colours have been made. The fine structure of the arc lines of a number of elements has been investigated. Central deflection of a square plate with clamped edges and subjected to uniform pressure over one surface, was also studied. (Department of Physics, R. I. Sc. Bombay).

CHEMISTRY

The work done at the Royal Institute of Science, Bombay is considerable and varied in nature. Reduction of Compounds containing the grouping-CHOH. CCl_3 with zinc and acetic acid is reported to show that the grouping–CHOH. CCl_3 is

reduced to CH_2. $CHCl_2$. A further study of the constitution of such reduction products of chloral and bromal amides has been made. The condensations of chloral and butyl-chloral with gallic acid, cresotic acids, methyl and ethyl o-toluidines, etc., have been effected (R. I. Sc. and Karnatak College, Dharwar) and a study of the nitration of the chloral condensation products of alkyl-aryl-amines has been made. Several sulpho- and nitro-derivatives of salicylic acid and its related compounds have been prepared and their constitutions elucidated (R. I. Sc. and Gujerat College). Some derivatives of benzylaniline have also been studied. The condensation of arylamines with substituted acetoacetic esters has been attempted with success. The condensation of acetone dicarboxylic acid with phenols and phenol ethers has been carried out. The condensation of benzanilides and p-dialkyl-anilines with phosphorus oxychloride as a condensing agent, together with a mechanism of the reaction involved has been studied. A new and direct synthesis of p-dialkylamino-benzophenones has been made and some interesting experiments on the synthesis of garcenine has been carried out. The anil-benzyl methanes have been found to undergo ring closure to quinazoline derivatives. A general synthesis of some quinoline derivatives through the condensation of benzanilide-imido-chlorides with malonic ester has been worked out, and the tautomerism of the derivatives investigated. (Mainly by the Department of Chemistry, R. I. Sc. Bombay and also those of Gujerat College, Ahmedabad, and Karnatak College, Dharwar.)

At the Baroda College a considerable amount of work has been carried out on the reactivity of a methylene group situated between two negative groups, with the help of reagents like sulphur monochloride, sulphur dichloride, sulphuryl chloride, thionyl chloride, chloro-sulphonic acid, selenium tetrachloride, iodine monochloride, oxalyl chloride, metallic sodium, etc., and the results obtained show that the reactivity is dependent on the nature of the groups attached to the negative groups and that the two hydrogen atoms also appear to differ in their reactivity Work has also been done on the synthesis of coumarins and their mercuration while the use of mercury acetamide as a mercurating agent has been established. Mercuration of amides and substituted amides of malonic, cyanacetic and acetoacetic acids has also been

effected with the help of ·mercurating agents, such as mercuric chloride, mercuric acetate, mercury acetamide, etc. Arsenuration of some organic compounds has been effected with the help of arsenic acid and is being futher studied. Reduction of substituted amides of bromo-malonic acid has been effected by means of phenyl hydrazine. (Dept.-of Chemistry, Baroda College, Baroda).

At the Fergusson College, some sulphur derivatives of 2 methoxy toluene have been prepared and studied: the decomposition of phenol and naphthol ethers, together with the velocity of their decomposition in the presence of halogen acids has been examined. Investigations were also carried out on the interaction of acids and esters, on the constitution of acids in solutions, on the additive compounds of m-dinitrobenzene and on the condensation of naphthylaldehydes with amines. Determinations of the velocitics of reactions in heterogeneous systems have been made.

(Dept. of Chemistry, Fergusson College, Poona).

At the Ranade Industrial and Economic Institute, the synthesis of coumaryl-4-acetic acid has been effected and the preparation of dimethyl-furo-coumarin starting from resorcin has been achieved. A definite proof of the oxidation of embellin to lauric acid has also been furnished. The anhydrides of glutaconic acids have been condensed with acetic anhydride and sodium acetate, to yield glutaconyl-acetic acids. The by-product obtained in this, led to a recognition of the possibility of para substitution in the condensation of acetone-dicarboxylic acid with phenols and phenol ethers. (achieved at the Ranade Inst. and later at the R. I. Sc.)

(The Ranade Industrial and Economic Institute, Poona.)

At the Karnatak College, Dharwar besides the work on the condensation of chloral, some research has been done on substances related to cochinillic and carminic acids. Chlor-alides derived from a-hydroxycarboxylic acids and their reduction products have been studied. (Dept.of Chemisty, Karnatak College, Dharwar).

At the Gujerat College, a comprehensive study of the derivatives of gallic acid has been carried out. The decomposition of ammonium nitrate, the interaction of iodine pentoxide and nitric oxide, and the combustion of charcoal in oxygen, nitrous oxide and nitric oxide has been carefully studied.

(Dept. of Chemistry, Gujarat College, Ahmedabad).

Considerable amount of work has been done on the physical side at the Wilson College, Bombay, such as the investigation on the boiling points of methyl alcoholic solutions under reduced pressure, the velocity of ionisation at low temperatures, the formation and properties of thorium hydroxide gels, the condition of silver chromate and some insoluble substances in gelatin and on colloidal gold and other colloidal problems.

(Dept. of Chemistry, Wilson College, Bombay)

On this side the Royal Institute has also considerably contributed by their study of silicic acid gels, the conductivity of liquid alkali amalgams and sodium aluminate solutions, reaction velocity in mixed solvents as well as hydrolysis of ammonium sulphide and ammonium carbonate solutions, studies in diphase systems, and X-ray examination of crystals of azo-benzene, copper formate dihydrate and o-azo-toluene, while some work has also been done on photo-reduction, on the formation and properties of nickelous oxide and the action of sulphuric acid on nickel-copper matte. Kinetics of homogeneous and heterogeneous organic reactions, such as a study of the benzoin reaction, the halogenation of toluene and its derivatives, the condensation of ethylene-chlorhydrin and p-and o-nitro phenols naphthols, resorcinols and their derivatives, is being made. Studies on magneto-electrochemeical phenomena and the electromotive behaviour of the cells Pt $\left| \begin{matrix} Cuo \\ Cu_2o \end{matrix} \right.$. n. NaOH and Pt $\left| \begin{matrix} Fe\,(OH)_2 \\ Fe\,(OH)_3 \end{matrix} \right.$ n. NaOH is being made.

From the same Institute, papers of theoretical importance such as the theory of the equation of states, the theory of the thermal decomposition of methane and calculation of the space displacement of terminal carbon atoms in ring formation, have appeared. (R. I. Sc. Bombay).

At the Baroda College, the viscocity and surface tensions of aqueous solutions of salts has been investigated. (Dept. of Chemistry, Baroda College, Baroda).

Esterification in mixed solvents has been studied at Sir Parshurambhau College, Poona, while studies in chromatic emulsions have been carried out at the D. J. Sind College, Karachi.

At the Agricultural College, Poona, the formation of the oil from the niger seed has been studied and its various constants determined. Nitrogen recuperation in the soils of the Bombay Presidency and the disintegration of bones (for manurial purposes) under various conditions of treatment, have been investigated. Movement of sulphate of ammonia and the decomposition of oil cakes in the soils, have been studied. (Dept. of Chemistry, College of Agriculture, Poona).

BOTANY.

A study of the photosynthetic activity of a leaf and its water content, indicated a close relation between the two. A new method for the quantitative determination of chlorophyll from tropical plants was devised and it was subsequently discovered that the photosynthetic activity of leaves is controlled more by the water content than the chlorophyll content of the leaves. A quantitative determination of the different carbohydrates formed in leaves exposed to diffused sunlight and to light from an electric lamp of equal intensity, showed that the amount of starch formed in artificial light is only one-third of that formed in sunlight, the amount of cane-sugar formed being nearly the same in both cases, and the total carbohydrates, one-half of that formed in sunlight. Photosynthesis was also found to depend not only on the energy content of the radiations of white light, but also on the wave lengths. Photosynthesis was found to progress normally in polarised light, though the absorption of light energy was found to be larger than in normal light; elliptically polarised light was found to possess a retarding action on the formation of carbohydrates in leaves.

Experiments on the physiology of the rice plant show that manuring them during the period of maximum growth range, gave better yields of straw and grain, that no advantage is derived by manuring the plants during the flowering period though the photosynthetic activity is highest then, that manuring will have very little effect on growth and yield if the plant is manured at that stage of growth, and that a mixture of ammonium nitrogen and nitrate nitrogen will result in better yields than when one of them is used singly.

Work has also been undertaken on the study of pectic changes in the potato tubers at different stages of growth and storage. The free soluble pectin increases as the age advances and as the rotting sets in; the downgrade changes begin to occur in storage conditions, the tissue is softened and the bacteria etc., get a footing. The same sequence of pectic changes is observed in the tubers studied, these changes being accelerated in hot weather.

The anatomy and physiology of climbing plants has also been studied. It was shown that when the tendrils are stimulated, the curvature does not occur on account of physiological causes. On a study of the histology of the tendrils, the cells which are able to perceive the stimulus, have been located. It was also shown that the conduction of the carbohydrates occurs mainly in the pholem and not in the xyem. (Dept. of Botany, Royal Institute of Science, Bombay.)

Work has been carried out on the cause of cotton wilt in India the Bajri smut fungus, the relationship of the species of Fusarium causing wilt and dry rot of potatoes, on the infection and prevention of smut in sugar cane, on the disease of Jowar caused by Sthacelia on the life-history of Cystoteora Oleae, of Uromyces Sp., of Jasminum Malabaricum, of Uromyces Aloe. Observations on Melanpsoralla Ricini, on the identity of Blastospora Butleri, on the Mucorineæ of the City of Bombay, on Puccinia Thwaitessi Berk, were recorded. Studies in microsporogenesis in Raphanus Sativus L. and somatic cell division in Aloe vera L. were undertaken. (Departments of Botany, College of Agriculture, Poona and Gujerat College, Ahmedabad)

A study on the rust fungus on the sun-flower has been made. (Dept. of Botany-Rajaram College, Kolhapur)

Marine Algae from Bombay, Dwarka, Okha and Karwar have been collected and many of them identified. The life history of Strepptodehalus, Volvox (Poona), Algae (Poona), Marsellia Quadrifolia, Moss (Poona), Anthocros (Khandala), Spalaginell (Poona and Khandala), Saluinia, Azolla, Equisetum and Ophioglossum as also the reproductive organs of Gnetum of Lonavala have been studied. (Dept. of Botany, Fergusson College, Poona.)

Papers on the Sea-grasses of the Bombay Presidency and on the Caulerpas of the Malvan Harbour have been published from the Wilson-College, Bombay.

(Dept. of Botany, Wilson College, Bombay).

ZOOLOGY.

The segmental organs which are functioning as Gonoducts together with the mechanism of several parts of each of the organs has been studied in Thalasema (Bombayensis), the true morphological nature of which has also been discussed. The anatomy, morphology and development of the same have been worked out. The correct course of venous circulation of Onchidium has been found out in contravention to that described by Cuvier and followed by Watson. Polychaete worms and larvae picked out from the Bombay harbour are being studied. The morphology and anatomy of Tetradon Oblongus (globe-fish) ound along the coast of Bombay have been thorougly worked out. The habits, anatomy and development of Lingula Anatina found in certain mud flats along the Bombay coast is being studied. Bionomics of some of the genera of Sipunculoidae (Bombay coast), such as Dendrostonae and Aspidosiphon is being worked out. Attempts are being made to bring about artificial fertilisation as well as to induce parthenogenesis. The elementary canal, the circulatory system, the nephridial system and the nervous system of an Indian polychaete worm (Okha and Karachi Bays) have been worked out. Studies in Placuna Placenta (Pearl Oyster) and on the Plankton in the Bombay harbour are in progress. A few stages in the life cycle of one of the Eimera (Fish parasite), afflicting fishes round the Bombay coast have been discovered. The time of getting the young ones of Harpodon Nehereus, the common and commercial fish in abundance during monsoon in Bombay harbour, the fish known as the Bombay duck, has been found out. Appropriate methods of sectioning and staining the specimens are being tried. (Dept. of Zoology, Royal Institute of Science, Bombay)

Excretion in Melipona during metamorphosis and a suspected sound producing organ in Empoasca devastans have been investigated.

(Dept. of Zoology Wilson College, Bombay.)

The cytology of pollen development in Carica papaya L., of Luffa aegyptiaca. Mill., of Aloe vera, of the male germ cells of Schizodactylus and the breeding habits of Calotes have been investigated. A study of the sexual cycle, the seasonal variation in the organs of reproduction of Indian lizards and of frog and investigation on the chromosomes of locusts, grasshoppers and other afmilies of Indian Orthoptera, and of Odonata and Neuroptera are under progress. (Departments of Biology, Gujarat College Ahmedabad and Ismail College, Andheri, Bombay.)

GEOLOGY

Gneiss around Gokak and those in the Belgaum District and the adjoining Dharwar Rocks, together with the Dykes intruding them have been studied. (The Department of Geology Fergusson College, Poona).

AGRICULTURE.

After a stndy of several draught-resistant and high-yielding strains from 1921 onwards, special strains of *Bajri* have been obtained giving increased yield of upto 14 %. A botanical study of various grasses and their comparative merits as food stuffs has been made; improved silage methods are now recommended for conserving grass for cattle-feed. Several selections of castor oil seeds of high oil content have been made and hybridised. This work is now being carried on in Gujerat. Remedies have been evolved for fighting potato moth. The *tambera* disease caused by mites is now definitely brought under control, and the spraying and dusting against the disease are now sufficiently popularised. A complete life-history of *Lavala* weed has been worked out. Investigation on Ganja hemp has been made, which indicate a mixture of several inferior and superior varieties perhaps due to natural crossing between the red and the green varieties. (Dept. of Economic Botany, College of Agriculture, Poona).

A comprehensive study of economics of farm management, of mixed farming with live-stock raising, details regarding the cultivator's farms from economic stand-point, marketing of some agricultural products and such other work in agricultural economics has been attempted. (Dept. of Agricultural Economics.)

Two insect pests are being investigated: for the last five years: (i) Scirto-thripsdorsalis (on chillies) and (ii)

Thrips tabaci (on onion) Their life-history and their continuous activity in breeding throughout the year on principal and alternate hosts; which are numerous, have been noted. They can be controlled to the extent of 60-80% by means of insecticides, though reinfection takes place. Manures like bone -meal, lime and potassium sulphate give a sort of immunity to plants. Aphis on cabbage is found to be a pest all over the area wherever the crop is taken. Three species appear to be identified and all the cultivated cruciferous plants appear to be the alternate hosts. The insect reproduces parthenogenetically and has a great power of reproduction. Artificial control is achieved by spraying contact poisons such as derrisol and others. The cochineal insect brought over from Coimbatore and acclimatised about Poona is spreading rapidly. With its help it is hoped that the growth of prickly pear will soon be under considerable control, (Department of Entomology, College, of Agriculture, Poona.)

The fungus causing the downy mildew of sorghum has been redescribed as a new species, Sclerospora sorghi Weston and Uppal. It has been experimentally established that Sclerospora graminicola is split into physiologic forms. One form attacks Pennisetum typhoideum only, while the other form attacks Setaria Spp. and Euchlaena mexicana. The downy mildew of sorghum has been shown to attack maize under natural conditions in Bombay, as well as Euchlaena mexicana in controlled experiments. Fusarium sp. causing wilt in sann-hemp has been shown to be disseminated through seed. Rhizoctonia bataocola has been shown to attack sorghum, cotton, castor, and groundnut in the Bombay Presidency. The study of Fusarium vasinfectum, the fungus causing wilt of cotton, has revealed that the death of the plant is not due to clogging of fibro-vascular bundles by the mycelium but by some unknown toxic substance. The disease spreads by means of infected cotton seeds. By using 3-5 oz. of 200 mesh fine powder of sulphur to 60 lbs. of seeds, the grain smut (Sphaecelotheca sorghi) of jowar has been completely controlled. Sulphured seeds when fed to cattle, bring about increase in their weight.. The powdery mildews of grape and cumin live over from year to year as dormant mycelium. (Dept. of Plant Pathology, College of Agriculture Poona).

The use of artificial manures, mixed with farm-yard manure for cultivation of different crops has been investigated on the Deccan trap soil. Cotton and Kharif Jowar are benefited to some extent by nitrogenous artificial fertilisers, phosphoric acid being either depressing or unnecessary. Bajri, ground-nuts and chillies are benefited with the above at 20 lbs. nitrogen per acre, and so also several other crops as shown in the following table.

Crop.	Manure.	Effect.
Cotton	Nitrogen artificial fertilisers	Benefit.
Kharif Jowar	Phosphoric acid	Depressing or unnecessary,
Bajri, ground-nut	Nitrogenous fertiliser	Benefit.
Chillies	20 lbs. per acre	
Winter Jowar	" " "	No benefit.
Onions	Do. 40 lbs. per acre	Definite advantage.
Suran	Nitrogenous fertiliser with 20 carts fram-yard manure	Benefit,
Ginger	" "	No benefit.
Sugar-cane	Basic dressing of green manure with Sann (Hemp) and top dressing of 75 lbs. ammonium sulphate and 75 lbs. nitrogen as any oil-cake	Economic and profitable.

Planting sets from the top half of the sugar-cane instead of the whole cane gives a better start and saves the lower half for crushing, thus reducing the loss of sugar.

The Agricultural Colloge Farm has done work in popularising iron ploughs and other agricultural improvements as well as engine-worked iron mills for crushing sugar-canes, and thus saving fuel.

Amongst the crop varieties, early ripening and easily harvestable ones not susceptible to Tikka disease and giving higher yields with greater oil content than the long growing local variety have almost supplanted the local types, as a result of trials on exotics from several countries.

After several trials about half a dozen sugar-cane varieties suitable for different soils and rainfall conditions in the presidency have been selected.

In the case of animal nutrition, ground-nut cake when replacing safflower cake in equal amount showed an increase of 5 per cent in milk with a reduction of 14 per cent in cost.

30-40 lbs. of dethorned prickly pear mixed with 6 per cent cotton seed has been found an excellent famine fodder.

Of breeds tried Sindhi cows and Surti buffaloes were found to be the most economical.

Storage of dry Jowar fodder (Milwa variety) for three years showed that there is a loss in weight ranging from 18-24 per cent. but that the feeding value is not impaired.

* * *

सृष्टिज्ञान

वर्ष ७ वें अंक १ ला,
जानेवारी १९३४.
वर्गणी २ रु.

आर्य भूषण प्रेस
पुणें.

शास्त्रीय ज्ञानाच्या
प्रसाराचें उत्तम
साधन.